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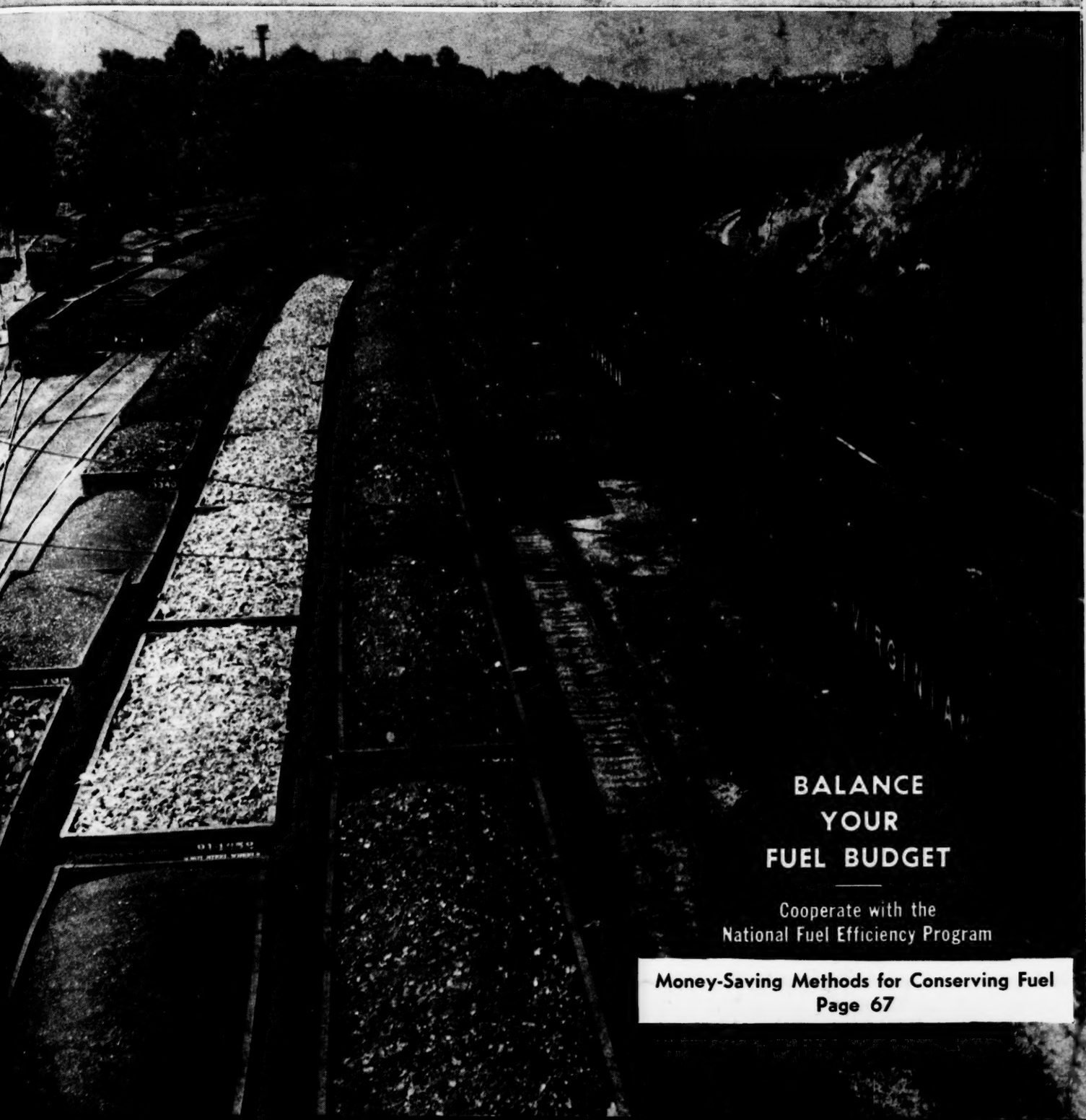
HEATING AND VENTILATING

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION



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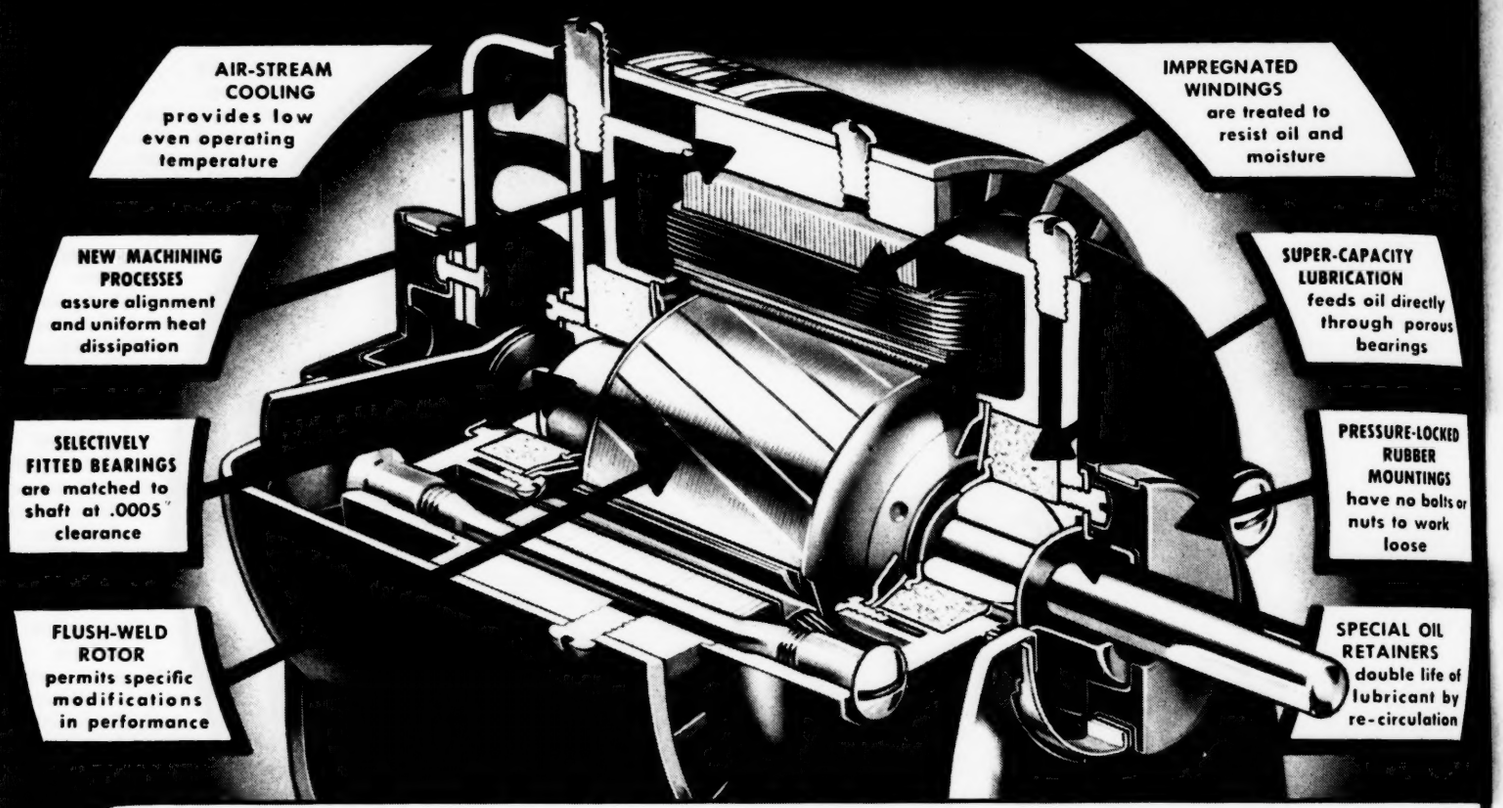
Money-Saving Methods for Conserving Fuel
Page 67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A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

HEATING AND VENTILATING

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CONTENTS FOR OCTOBER, 1944

VOLUME 41 NUMBER 10

Refrigeration in Medicine and Surgery 55
N. N. Wolpert

Study Trolley Car Ventilation 57

Gas Heat Processes Vermiculite Ore 58
Fred A. Herr

Controlled Air Conditions for an Airplane Plant 60
A. D. Engle and W. W. Frankfurt

What the Ventilating Engineer Should Know About Toluene 62

Refrigeration of Coolants for Machine Tools 63
B. S. Williams

106 Separate Ventilating Systems for Troop Ships 66

The Factory of the Future 66

Reference Section—Money-Saving Methods for Conserving Fuel 67
T. W. Reynolds

Duct Leakage and Job Revisions 83
E. L. Schulz

Spontaneous Combustion of Coal and Its Prevention 85

Oil Piping—Its Design and Application (Part 2) 86
Harry D. Unwin

Ventilation Laws Not Definite Regarding Air Weight 91

Washington News 92

News of Equipment and Materials 94

Reference Data 279-280 98

News of the Month 100

What Readers Say 104

Since the Last Issue 106

New Catalogs 114

Coming Events 116

Army-Navy "E" Awards 116

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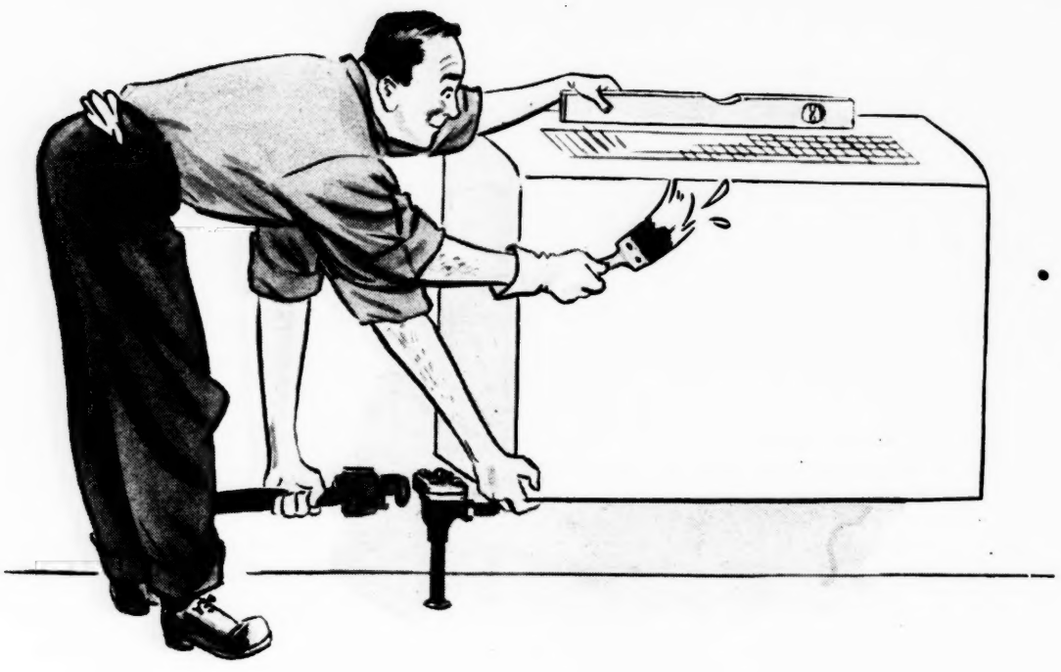
NEXT MONTH'S ISSUE

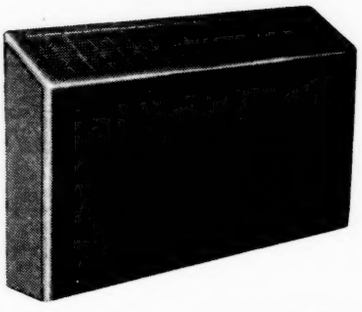
Another in the series of Blueprints of Post-War Realities devoted to Central Steam Heating Systems for Large Building Groups will appear in next month's issue. The third installment of the series on oil piping will cover sizing of the piping. Air conditioning loads, air cleaning, and servicing will be treated in Mr. Schulz's series on Air Conditioning.



ONE MAN DOES THE WORK OF FOUR

when TRANE Convectors are installed

Light Weight Heating unit not only saves installation time but can now be shipped sooner



When Trane Convectors were installed at a west coast naval hospital it was possible for one man to do the work of four. Here's why—

Trane Convectors weigh one-fourth as much as conventional cast iron heating units. The same crew of men can unload four convectors to one cast iron radiator. Wall hung Trane Convectors can be completely mounted in the same time it requires to mount only the hangers for cast iron radiators. The smooth surfaces of the Trane Convector can be painted much faster than the rough hard-to-get-at surfaces of old-fashioned heating units.

Of course thousands of convectors were installed in this big naval hospital. But proportionately the same amount of installation time can be saved on all jobs, small or large. Whether for one war worker's home, or a factory to build B-29 bombers, Trane Convectors save valuable man-hours at a time when every minute of every worker is vital.

Not only that, but today Trane Convectors can be shipped faster. Trane Convectors are not dependent on manpower-drained foundries. In most instances Trane Convectors can be shipped in one-third the time required for cast iron radiators.

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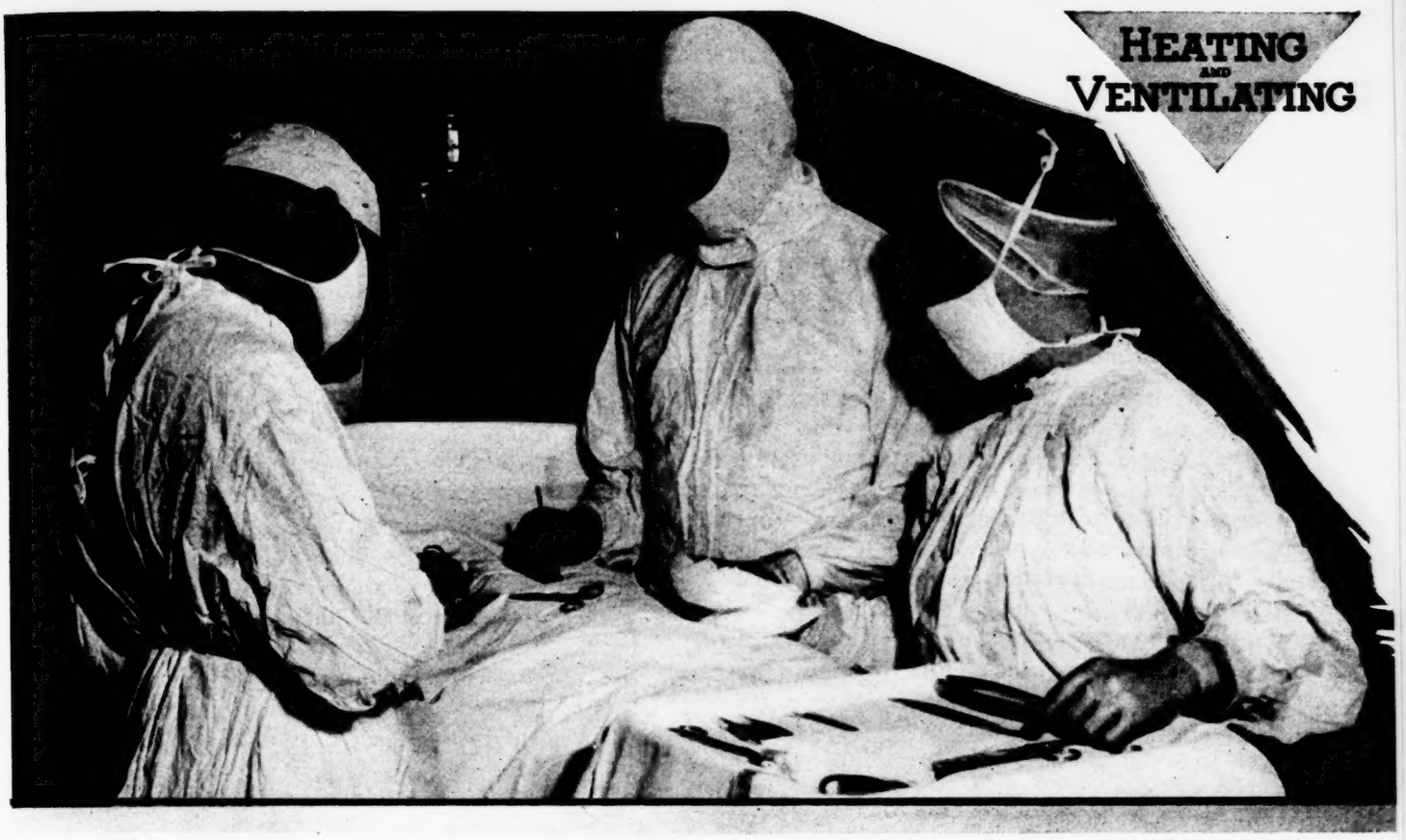
AIR CONDITIONING HEAT TRANSFER AIR HANDLING EQUIPMENT

Information for this advertisement furnished by H. C. Hastorf of San Francisco, a heating contractor on this mammoth government project



Refrigeration in Medicine and Surgery

N. N. WOLPERT
Associate Editor, HEATING AND VENTILATING

REFRIGERATION, employed and accepted widely by industry to improve the quality of manufactured products or to further processes, is now being used in medicine with marked success as an anesthesia or as a form of therapy or cure. While at present reports have been made before many medical societies on almost miraculous results following limb amputations in patients often 80 years or older, it is the opinion of Dr. Frederick M. Allen, a pioneer research worker in this field, that refrigeration will have even greater uses in the treatment of severe burns.

The entire subject is termed hypothermia, and the field for the purpose of this article is divided into cooling the body as a whole (systemic hypothermia), and local hypothermia, into which falls the very important phase of refrigeration as an anesthesia prior to the amputation of limbs.

Systemic hypothermia was introduced by Dr. Temple Fay about 1938. He discovered the possibility of reducing body temperature rapidly and comfortably to levels lower than had previously been imagined possible. Reductions to 90F are moderate and often 80F can be tolerated with safety for several days. Popularly, systemic hypothermia is referred to as artificial hibernation, or body sleep, although some doctors object to the term hibernation, claiming that it should be used to describe the result of a chain of complex physiological body reactions. The body is neither frozen nor temporarily devitalized, as some believe. The patient remains in a numb, semi-conscious state, and although able to answer simple questions, drink fluids and void urine, he remembers nothing of what has taken place during the treatment, after the body has again regained its normal temperature.

Cancers and Tumors

Through brief articles in newspapers, the public has been encouraged to believe that hypothermia will retard and even destroy completely cancerous growths in the body. It is difficult to report with authority on this type of cold therapy, for about five years must elapse after treatment before a cure can be claimed. There is always the danger that even after treatment, a cancerous growth may again develop.

In general it can be said that cold has not been successful in the treatment of cancer although it is hoped that hypothermia in combination with some form of irradiation such as X-ray or radium, or in combination with surgery, may be the long sought for answer.

However it does bring relief from the intractable pain associated with advanced stages of cancer, and it is effective where pain resists medication with opiates.

Gas Heat Processes Vermiculite Ore

FRED A. HERR

Expanding kiln used by the Standard Insulation Co., for exfoliating vermiculite ore. High temperature heat expands the flakes to 15 times original size.

APPLICATION of controlled heat figures prominently in two major production processes employed in the plant of the Standard Insulation Co., Inc., Los Angeles.

It is used in the exfoliation of raw vermiculite ore from which insulation material is produced, by exposing the ore in its original flaked form to 1400F in a series of gas-fired expanding kilns.

Temperatures ranging from 600 to 1,200F are used during dehydration to remove all chemical and free moisture from the vermiculite products routed through the tunnel.

Vermiculite processing was introduced comparatively recently on the Pacific Coast. In response to increased demands for insulating materials in the western states, the Standard Insulation Co. was established shortly before the outbreak of World War II in 1939 to treat western vermiculite ore.

The ore, through various processes and heat applications, is converted into insulation material of extremely high heat-resist-qualities. The finished product is suitable for insulating from below-zero temperatures to 2,400F.

Vermiculite is classified minerologically as a laminated, micaceous product, a hydrous aluminum silicate. It is so named because of the vermicular or worm-like design which the flakes assume in the process of exfoliation under the influence of heat.

Standard Insulation Co. obtains its material in four sizes from mines located in Nevada. Raw material is graded and sized at the mine because vermiculite, once it has been exfoliated, cannot be sized without causing the flakes to break down with an excess of fine dust. The original material, in the shape of small lead-colored flakes about the size of corn flakes, is transported loose in box cars to the Los Angeles plant.

Vermiculite, under the application of heat, puffs up to many times its original size because it is hydrous, with considerable free moisture trapped between its laminations. Research in geological laboratories has determined that the flakes contain as high as a million minute laminations to the inch. When the flakes are exposed to sufficient heat, water in the microscopic laminations is transformed into steam and literally explodes the flake so that it becomes 15 to 20 times its former size. The action is not unlike the popping of corn.

Millions of minute sealed air cells are entrapped in the vermiculite by the explosion process, resulting in a product capable of resisting heat up to 2,400F, without fusion, and impervious to acids.

Upon arrival at the company's plant, the flake vermiculite ore is fed into one of three expanding kilns. These kilns are vertical furnaces roughly three feet square and 12 feet high. Each furnace interior is divided into a series of chambers, one above the other, and fitted with baffle boards mounted to the side walls at 45 degree angle. The kilns are gas fired, being equipped with premix surface combustion burners having a maximum consumption of 1,200 cu ft per hour. Kiln temperature is maintained at 1,400F during the process of exfoliating the flakes.

Raw material is ready for processing upon arrival at the plant. The ore is automatically fed from a hopper to a bucket elevator and then dumped through an opening in the top of the furnace. The ore passes downward through the furnace with the baffle boards turning the flakes over repeatedly and so exposing them to heat on both sides. The downward passage of the ore requires approximately one minute, during which time the high-temperature heat has reacted on the ore to complete exfoliation and puff the flakes into 15 times the size they were when they entered the top of the furnace.

After exfoliation, the particles may be more accurately described as "accordion" shaped. They are roughly one-half inch long and slightly less in breadth. They have changed from their original

lead color to a golden hue because of oxidation during exfoliation.

The exfoliated material emerges from a 12-in. square door at the bottom of the expanding kiln, is re-elevated to a large second floor storage hopper, and is then ready for the next process.

Before being manufactured into various types of insulating products, the granules are graded or sized. This is done on a set of grading and cleaning screens. A turbo blower at one end blows the material across the screens and permits impurities to drop out. Vermiculite is graded into granules of four different sizes.

The granules are used in the manufacture of insulation products. For home insulation, where it is used for loose-fill in walls or above ceilings, large size granules are used. This type is immediately sacked after grading and cleaning and is sent to the warehouse.

A mixture of two smaller size granules is employed in the fabrication of bricks and blocks used in various kinds of industrial plant insulation. From the smaller granules are fabricated lightweight insulation bricks for backing up fire brick in furnace walls. These bricks weigh about 18 ounces, and are designed for direct heat exposure up to 2,000F and to withstand unusual shock due to sudden temperature changes.

The granules also are fed into presses and compressed into square and oblong slabs and blocks in backing up refractories in furnaces, heaters and ovens, are hand molded into special shape, and are pressed into standard pipe covering segments.

Other granules are combined for use in lightweight insulating plaster, another type into insulating plastic for use on boilers of all types, furnace roofs, feed water heaters, heat exchangers and refinery towers. The plastic insulation is also used to fireproof structural steel supports in refineries and industrial plants.

Application of high-temperature heat is an important process in the final fabrication of insulation blocks, slabs and pipe coverings. After the articles leave the molding machines they are moved to the drying or dehydrating tunnel. The drying tunnel is 106 ft long, 7 ft high and 6 ft wide, and is constructed of vermiculite material.

Articles to be dehydrated in the tunnel—bricks, slabs, blocks, pipe covering sections—are removed from the air drying racks to steel rack cars, which are shunted into the tunnel on rails running the length of the dehydrator. The tunnel is just wide enough to accommodate a car and will take 20 cars at a time.

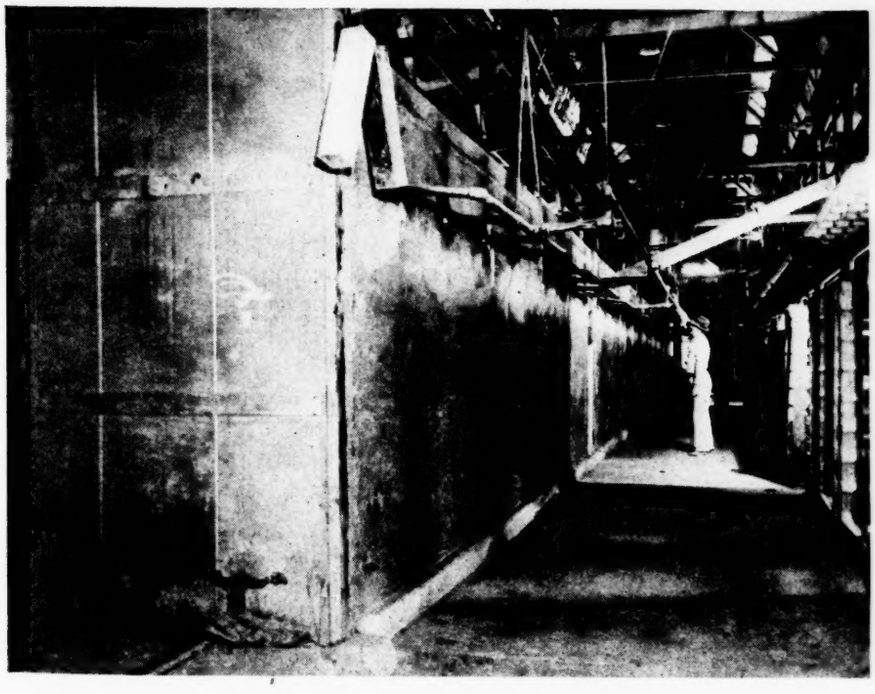
The continuous process type dryer can remove approximately three tons of moisture per hour. Firing with natural gas is accomplished with jets at the top of the dryer. The firing installation consists of 64 burners using air-gas mixers which have a maximum consumption of 4000 cu ft gas per hour. While 1,200F temperature can be produced in the tunnel, but 600F has been found sufficient to remove all chemical and free moisture from the bricks and slabs. Cars are kept in the tunnel from 8 to 12 hours.

Gas jets are installed at the side and near the top of the tunnel structure and fire directly across the upper part of the dryer. The direction of the heat stream is horizontally across the load, passing about 12 in. above the top of the loaded trucks.

A 6,000 cfm exhaust fan, installed in a duct at the bottom of the drying tunnel, draws heat down through the loaded trucks. The same fan is used to carry out moisture from the dryer itself, through a series of venting gaps in the floor of the tunnel between the rails.

The insulating slabs and blocks, when removed from the drying tunnel, are trimmed and packed in cartons, ready for shipment. The bricks are sent through a sizing machine to assure accuracy of dimensions before drying.

In addition to their uses for home and industrial insulation, vermiculite products are being widely used in Army and Navy installations. Insulating monolithic plastic is used for pipe covering in high octane plants, and other types of insulation for fireproofing roof decks and warehouses in Navy cantonments.

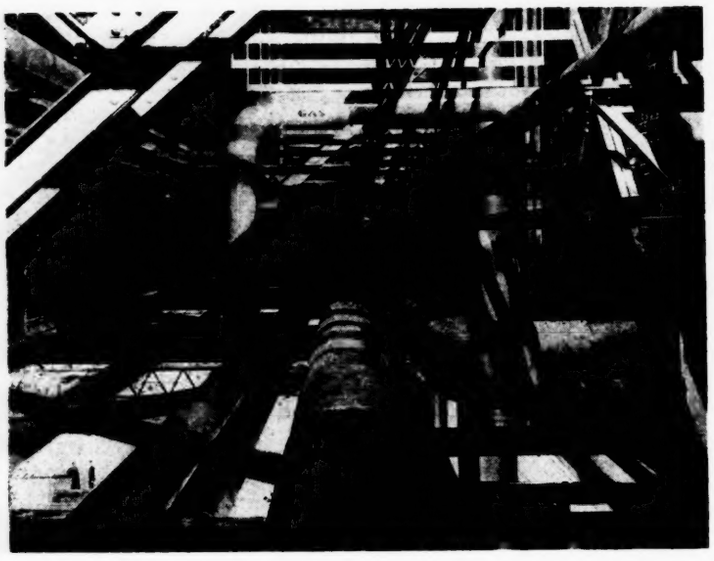


Exterior of the drying tunnel. Sixty-four air-gas mix burners are installed in the tunnel in positions corresponding to the outside gas piping.

Controlled Air Conditions for an Airplane Plant

A. D. ENGLE
Project Engineer, and

W. W. FRANKFURT
Project Mechanical Engineer, The Austin Co.



With the pipe lines concentrated in the trusses, the working area of the plant is entirely free from obstructions. This is a view taken alongside the boiler house wall.

DESIGNS for air conditioning systems and other mechanical facilities at the windowless plant of the Douglas Aircraft Co., Oklahoma, were developed around standard units as far as possible. The object was to insure a minimum of difficulty in future replacements and maintenance, and also to expedite delivery of the equipment.

The outside masonry walls have an interesting design feature. In this plant, designed by The Austin Company for the U. S. Army Engineers, there are nearly two miles of "breathing" walls. The breathing action or interior wall ventilation is caused by open vertical joints in two recessed courses of brick. One course is about waist high from the ground and the other a foot below the limestone coping. Vertical tile cells permit air to circulate from the open joints on the bottom of the walls to the air exhaust near the coping.

The heart of the air conditioning system is in the boiler house where eight 1075-ton centrifugal-type refrigeration machines cool 18,200 gallons of water per minute. The machines are located on concrete decks 12 ft above the main floor. Each compressor is driven by a steam turbine operating at 215 lb steam pressure, with exhaust condensing at 26 in. mercury. For simplifying piping connections, steam condensers and condensate pumps are located under each refrigeration machine on the main floor. Adjacent to, and in full view of the refrigeration decks, is the main air conditioning control panel which gives the operator a full picture of the actual operating conditions throughout the plant.

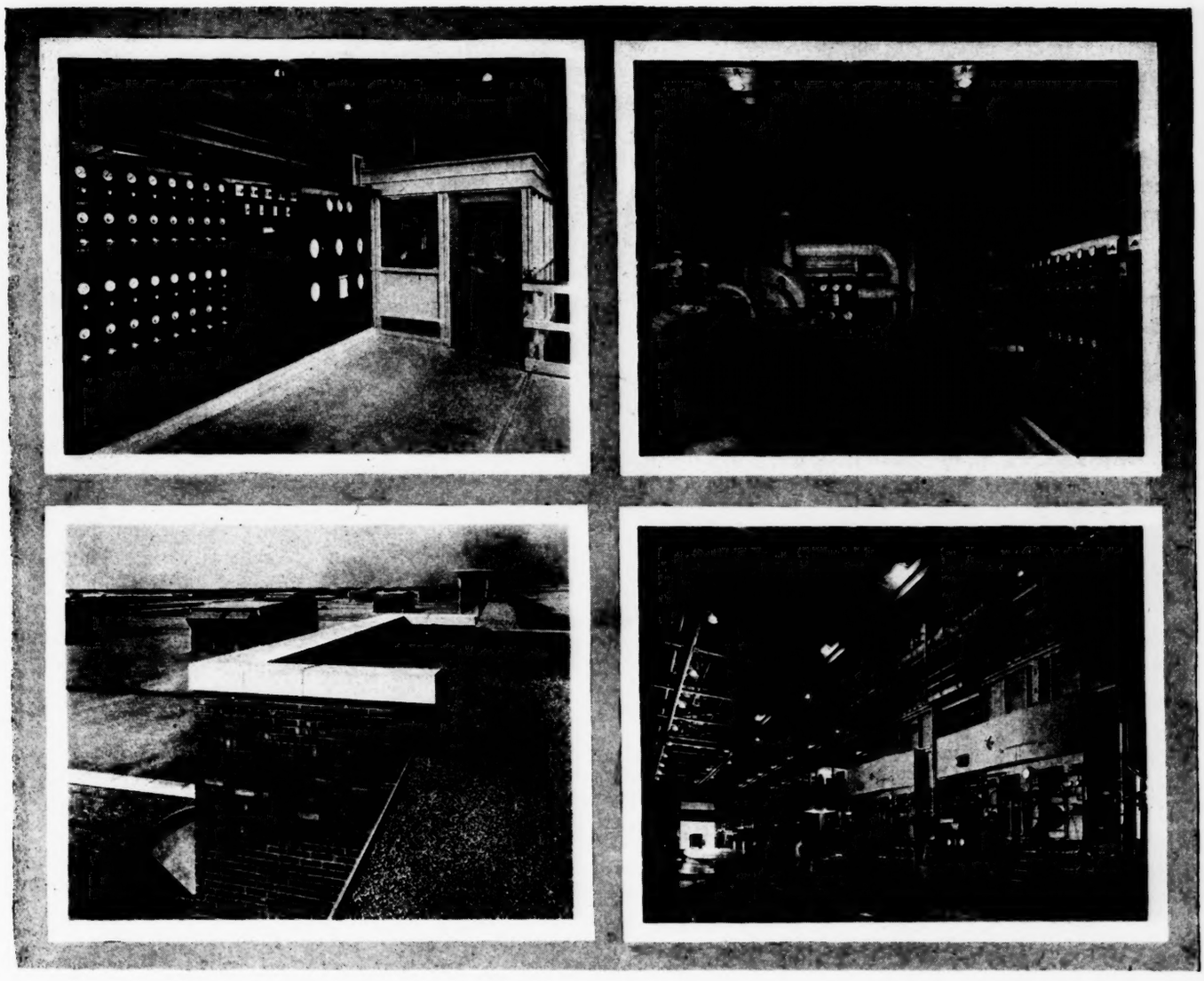
A 9-section induced draft type tower designed to cool 26,100 gpm was erected on a concrete basin with 5 sump pits located on one side. A low-head, deep-well type pump was installed in each sump pit for circulating condenser water to the refrigeration and steam condensers. Some 200 gpm water returning from processing equipment is used for water make-up at the tower, thereby conserving water. The 42 in. underground condenser headers at the tower are anchored by concrete thrust blocks designed to fix the pipe and prevent any expansion in the line along the tower due to temperature change. These thrust blocks permitted the use of lighter gauge pipe and branches, thereby saving critical material. Condenser water is also used for cooling the gas-engine-driven air compressors the year round.

During the winter one section of the tower, together with a small circulating pump, is used for the gas engines. Piping at the tower is so arranged that depending upon the outside temperature, water can either be discharged at the top of the tower or directly into the basin. In the event that the temperature drops below freezing, steam pipe coils have been installed in this one basin to prevent freezing of the water. Cooling tower water is also used to cool the water cooled bearings on the induced and forced draft fans on the boilers and boiler feed water pumps.

The main boiler house building columns were utilized to support the 24 in. chilled water headers and branches to the coolers on the refrigeration deck. The chilled water system is divided into four zones, each having its own circulating pump, together with sectionalizing valves and by-passes so that in case of an emergency, pumps can be cross-connected. A total of 18,200 gallons of chilled water

The main air conditioning control panel is located directly adjacent to the engineer's office on the mezzanine floor. An operator can follow the actual performance of all air conditioning units throughout the plant by noting the indicators on this panel.

At the left is one of the 1075-ton York centrifugal refrigeration compressors driven by a Worthington steam turbine. An individual control panel for this assembly is at the rear. Two large vertical lines supply chilled water to circuits in the assembly building.



A detail of the "breathing" wall which provides an insulating effect equivalent to 80 in. of brick. Open vertical joints near the limestone coping form the exhaust ports for the continuous ventilating flue in the wall. Circulation is obtained through vertical flue tile behind the facing brick. At the right is a roof observation tower for plant guards.

Two of the high pressure water wall type boilers are in the foreground. They are combination gas and oil fired. In front of each boiler is a control panel. The gas line, the oil lines and continuous blow-down lines are in a trench below the floor in front of the boilers. From the engineer's office, right, is obtained a clear view of full operating floor.

per minute is transported through pipes to the various fan decks throughout the building. Light gauge spiral pipe was used where practical.

Units and Piping in Trusses

Due to clearance requirements of the overhead monorail covering the entire ceiling, the air conditioning system had to be completely installed above the lower part of the trusses. Two complete air conditioning units were assembled on each of the thirty fan decks, which condition 3,500,000 cfm. A pent house located above each fan deck, takes in outside air and expells the used air through relief dampers. Air is distributed from each fan deck through ducts to ceiling type air diffusers located on 60-foot centers.

Special heating control equipment was provided for large vertical lift doors by installing a thermostat at a low level and, when calling for heat, will open a steam valve in the line to the booster coil located in the branch duct. As the air temperature rises in the duct, a heat actuating device located at the air diffuser, automatically opens its bottom vanes and directs the hot air to the floor, thus compensating for this varying infiltration load. Fan decks are connected by a network of cat-walks which permit op-

erators to make adjustments without affecting the production operations below.

Boilers Serve Heating and Cooling Functions

Boilers operating at 215 lb pressure, saturated steam, of the water-wall type, gas fired with oil standby were installed. The forced and induced draft fans and boiler feed water pumps are steam-turbine driven, utilizing exhaust steam for boiler feed water heating. During the winter, the boilers furnish steam primarily for heating and processing equipment; during the summer, for the refrigeration machines and processing equipment. Peak loads of both the summer and winter seasons are approximately equal in amount.

A hot process water softener is used for treating boiler feed water to protect boiler tubes and drums against scale and corrosion. Low total solids are maintained in the boilers through a continuous blow-down system, thereby producing high quality steam. The boiler blow-off discharges through an aspirator located below the water line, into a concrete tank located below the boiler room floor to provide thorough circulation and mixing of the hot condensate and the water in the tank before discharging to the sewer. Cold water is admitted at the throat of the aspirator by the operator during blow-off periods. By diluting the hot condensate with cold water excess strain to the concrete tank due to temperature rise is avoided.

Compressed air at 100 lb working pressure is provided by five 2-stage compressors. Two are direct connected to 300 hp, 4160-volt synchronizing motors. The other 3 are twin, 2-stage, horizontal type, combined with 8-cylinder 300 hp vertical gas engines. Each gas engine is also direct connected to a 200 kw, 4160-volt fly-wheel type generator. Any two will handle the emergency lighting loads in the event of main power failure. Provision is made for automatic unloading of compressors during this period and placing air compressors back to normal operation when the generators unload. A two-way damper is provided at the air intake so that the operator may take the driest air from either inside or outside the building, depending on the moisture content. A loop system is provided with the compressors located near the heavy concentrated loads. Numerous drops are made at columns for processing equipment and large machines. Air service outlet boxes have been provided in the floor for small hand tools.

Acetylene gas is supplied by two 300 lb double duty generators, oxygen and hydrogen by manifold cylinders, all located in one central plant. The three gases are distributed by pipe lines identified in distinguishing colors to the various welding areas. Tile welding booths were provided to confine welding operations and to protect employes' eyes from ultraviolet rays.

What the Ventilating Engineer Should Know About Toluene

The enormously increased use of toluene during recent years has led to studies both by the New York State Department of Labor's Division of Industrial Hygiene and the U. S. Public Health Service. Large amounts of toluene are being used as a component of paints and, in addition, toluene plays an important role as a starting material for the manufacture of TNT.

It was formerly assumed that the maximal permissible concentration of toluene was about 200 parts per one million parts of air. Studies were undertaken by the U. S. Public Health Service, however, to establish the validity of this permissible concentration figure.

The Public Health Service studies indicate that single exposures of humans for 8 hours daily to concentrations of toluene ranging from 50 to 800 ppm do not cause definite changes of the white blood cell picture, of the circulation, or of the respiration. Inhalation for 8 hours of concentrations of 200 ppm causes slight but definite impairment of coordination and reaction time which may render persons thus affected more prone to accidents. With higher concentrations these effects become increasingly more marked, and with concentrations of 600 and 800 ppm they may be observed after a few hours' exposure.

With regard to maximal permissible concentration of toluene in air the Public Health Service experiments showed that toluene has essentially narcotic properties and that continued exposure to a concentration even as high as 5,000 ppm is not liable to cause definite injury of the blood-forming organs, the liver, or any other organs. Toluene is therefore less toxic with regard to the blood and blood-forming organs than benzene, and with regard to the liver less toxic than carbon tetrachloride, the maximal permissible concentration for both of these being considered at 100 ppm. Since exposure of human subjects for 8 hours to 200 ppm was found to produce slight but definite changes in muscular cordination, this concentration may render individuals more prone to accidents.

According to the findings the repeated exposure of animals and humans to such concentrations causes no discernible untoward effects on their health. It appears, therefore, as far as toxicity is concerned, that the maximal permissible concentration for toluene in air for 8 hours' exposure daily is 200 ppm. In operations which offer specific accident hazards this concentration may prove to be too high and therefore undesirable.

Refrigeration of Coolants for Machine Tools

B. S. WILLIAMS

Industrial Research Department, Airtemp Division, Chrysler Corporation, Dayton, Ohio

With the high cutting speeds employed in modern machine shop practice, high temperatures at the cutting edge of the tool obviously result. These high temperatures may cause (a) a welding action between the chip and the tool, and (b) a softening of the tool edge. When either of these occur the result is a poor finish, excessive tool wearing, and perhaps considerable loss of production. To reduce these high temperatures, refrigeration of the coolant or cutting oil has been successfully employed, as described in the accompanying article by an author who has been closely identified with an important program of original development work on this subject.

THE need for application of mechanical refrigeration to the oil or coolant circuit on a machine tool was first brought to our attention about two years ago by a large aircraft manufacturer. His problem was to increase production of landing gear cylinders drilled out of solid steel stock. The tool employed was a hollow drill which took a cut 4½ in. in diameter, 26 in. deep.

Coolant flowing over the drill gradually increased in temperature to 157F, at which point the drills would burn and frequent tool changes were necessary. So much time was spent in adjustment, changing tools, and stopping the machine to let it cool off, that production was seriously hampered. Burning and breaking of cutting tools when coolant temperatures rose to 157F created an excessive tool cost.

This problem was solved by cooling the cutting oil flowing over the work to approximately 70F. After this had been done, the cutting time for one cylinder was reduced from one hour and 50 minutes to one hour. Burning and breaking of drills was materially reduced, and less adjustment of the machine was required.

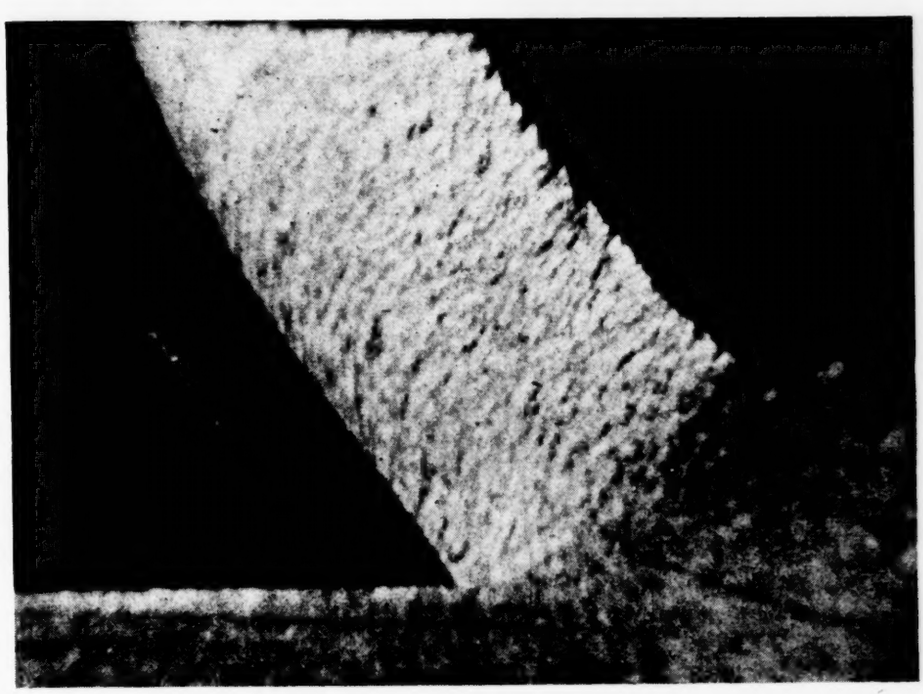
To better understand this spectacular success, which has since been verified in a number of similar refrigeration applications, it will be well to examine the basic theories and ideas which underlie this new and important technique.

The war has brought about many changes in methods and materials used in the operation of machine tools. Demands for faster production and greater precision were followed by the introduction of new alloys and new cutting tools. To meet these new production demands, and the attendant conditions created by faster operation of machine tools, master mechanics must select the right combination of tool, lubricant, speed, and feed that will produce the desired results.

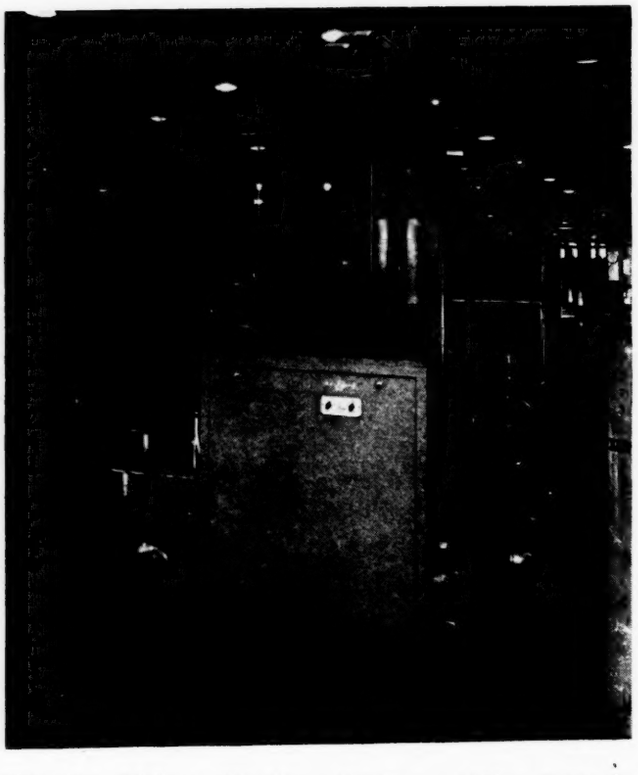
When oil temperatures rise, due to the accumulation of heat generated in the cutting process, often a water compound is substituted to control temperature by means of natural evaporation to the air. Many of these compounds have poor lubricating qualities; the result is excessive tool wear and tool breakage.

While oil may be desirable from the standpoint of lubrication and finish, it does not have good cooling properties, and will rise steadily in temperature while the machine is running. Excessive heat in the coolant will shorten tool life and will prove undesirable.

Let's look at what happens when a tool bites into



Microphotograph of a tool cutting into steel shows how the chip metal flows away from the work piece over the cutting edge of the tool. Intense heat generated at the point of cut is given up to the cutting oil or coolant and can be removed from the coolant by mechanical refrigeration to maintain stable conditions. Photo courtesy Cincinnati Milling Machine Co.



Chrysler Airtemp liquid cooler for machine tools installed in connection with a vertical drill in a large motor plant. Individual cooling units are recommended for each machine tool so that coolant or cutting oil may be held at the desired temperature on each machine.

metal. Examination under a microscope of a tool cutting into steel reveals that the chip just above the cutting edge of the tool flows away like molten lava and appears to be soft and fluid. Actually, in many operations, metal flowing from the work piece is red hot, even though this condition is not apparent to the naked eye. As it cools, the molten metal hardens and forms a continuous chip, which slides over the tool in the form of a ribbon.

When cutting cast iron, the chip fractures into tiny particles.

Why Refrigeration is Needed

We recommend that the coolant which flows over the work on a machine tool be maintained at a constant temperature, the year around, irrespective of room temperatures. This temperature should be sufficiently low to limit the heating of the work. Usually it is not necessary to operate below 70F to obtain the desired result, and there is little advantage in going above 85F.

Many advantages are gained by maintaining the oil at a constant temperature.

1. Longer tool life. Excessive temperatures of the cutting oil or compound cause cutting tools to soften and wear rapidly. High temperatures at the point of cut often build up metal to weld to the face of the tool. This causes frequent changing and grinding. Application of refrigeration to the cooling system on the machine tool has reduced sharply tool replacement cost and also the time lost in changing tools.

2. Less machine adjustment. Changes in dimensions caused by changes in cutting oil temperature must be compensated for by frequent adjustment of the machines. Machine tools must also be adjusted to compensate for tool wear, and this takes considerable time. The delay causes loss in the productive time of the machine and operator.

3. Better location and tolerances. Rising coolant temperatures cause changes in the machine set-up, making it difficult to hold accurate location and diameter of work. Units machined at one temperature have a different size from work finished at another coolant temperature. Many rejects may follow.

4. Cooler work pieces. When machined work is too hot to handle, as is often the case when coolant temperatures become too high, the pieces cannot go on to the next operation immediately. This prompts a delay in production.

5. Control of run-outs. When excessive heat is present at the point of cut, drills tend to change direction and run out of alignment, making it necessary to back up frequently so the work can cool. Control of cutting oil temperatures makes it possible to operate the drill at faster speed, without delays due to run-outs.

6. Uniform oil viscosity. Cooling will hold cutting oils at the desired temperature and therefore at a constant viscosity. This is highly desirable, because when oil rises in temperature its viscosity changes until the oil becomes so thin that the proper lubrication is impossible. When viscosity is greatly reduced, tools burn or break, and imperfections appear in the work surface.

7. Water consumption reduced. When city water is used to cool a machine tool, it is normally discharged into the sewer. Large quantities are wasted, materially increasing the production cost. Savings in city water consumption will often materially help to pay for the refrigeration system.

8. More uniform results. Production of precision work pieces is dependent upon the maintenance of stable conditions. Because the rising temperature of the coolant affects the operation of a machine tool in so many ways, a constant temperature is important.

9. Increased production. With the refrigeration system installed, most machining operation speeds may be increased, thereby increasing production.

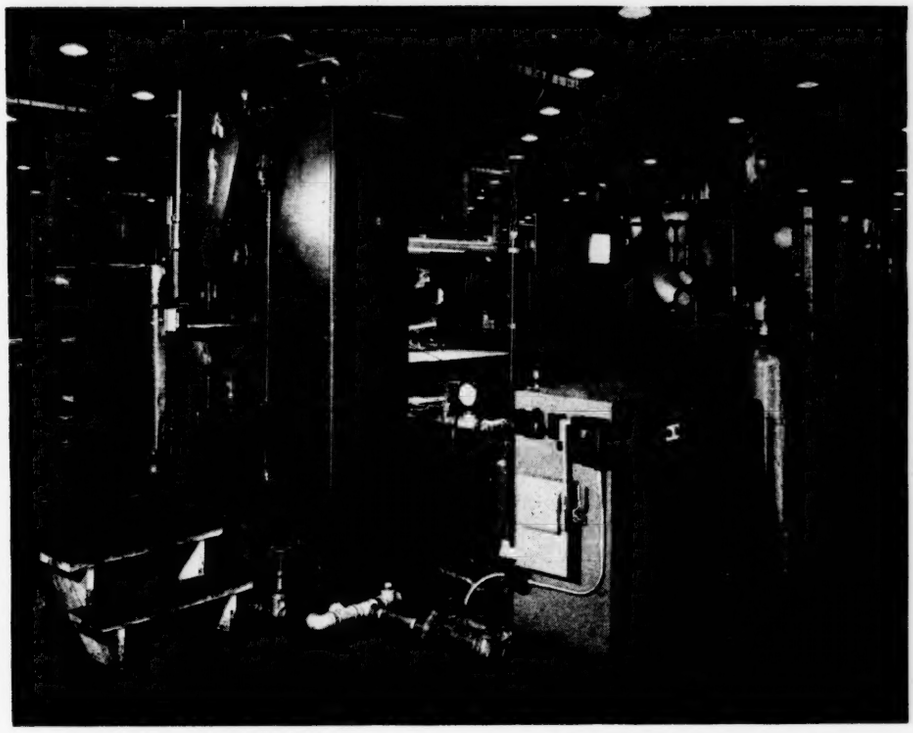
Because of the many variables in machine tool operation, Airtemp research engineers found it difficult to obtain an accurate picture of increased production. We can report, however, that test installations show a substantial increase in production where coolant has been applied to machine tools. In certain cases, savings appeared so great as to be out of line with anything that could be reasonably expected in a refrigeration application of this kind.

In all cases every effort was made to see that the machine tool was producing the best result possible before the cooling unit was installed. It was then possible to determine the effects of the refrigeration

application with some degree of accuracy.

Another case studied was an automatic lathe for machining tank tread parts made of manganese steel. The machine is a six-spindle automatic chucking lathe, which performs all operations on the part, including cutting the threads. Coolant is led to the work piece through a circular header from which small pipes lead to all positions. The coolant was a special oil used for cutting, chasing, and threading.

Because of the extreme hardness of the manganese steel, many problems were encountered. Temperature of coolant delivered to the work piece was approximately 98F and under this condition some difficulties were experienced.



The Chrysler Airtemp liquid cooler for machine tools (right center foreground), installed on a vertical drill in an aircraft motor plant, maintains cutting oil temperature at the desired level. Production was increased from 48 pieces per day to 60 pieces per day after the oil cooling unit was installed.

Because of excessive strain on the machine, clutch and other mechanical troubles caused lathe stoppage. Repairs were necessary. Tools used in cutting manganese steel had to be ground and replaced frequently. Tool adjustment on various parts of the machine was excessive. Work pieces coming out of the machine were too hot to handle, fumes created by burning coolant were highly objectionable, and city water consumption (which did not properly cool the lathe) was great.

To remedy these conditions a cooling unit was installed to cool the coolant to approximately 70F. After the refrigeration equipment was operating, these problems were either eliminated or were greatly reduced. While in this instance it was not necessary to increase the productive capacity of the lathe to the maximum point made possible by the application of refrigeration, it was found that the cooling unit was an excellent investment.

Equally interesting is a problem encountered in the operation of a twin spindled inverted type Baker drill used to bore 1¾ by 18 in. holes in solid steel forged stock which tested from 290 to 350 Brinell hardness.

Using a sulfur base cutting oil, the drill could produce only 24 pieces per 9-hour shift, due to breaking of spade cutters and jamming of chips. Excessive heat at the point of cut badly burned the spade cutters. Many times two sets of cutters were required to drill one hole. Work piece temperature under these conditions increased to 130F on the outside, indicating that intense heat was being formed at the point of cut.

When the coolant cooling unit was installed and the coolant cooled to 70F, production was increased from 48 pieces per day, on the basis of two shifts, to 60 pieces per day. This resulted in a saving of 60 days' production time out of a 300-working-day year.

Reduction in tool changing, tool grinding, and tool replacement showed even greater savings. Much less coolant was required each day.

A third case history further illustrates the value of cooling oil circuits on machine tools. This problem was to increase the production of horizontal deep hole drills having a bed 30 ft long. When these drills were first put in operation the tools only had one cutting edge. With this drill, the time required to finish two pieces simultaneously was four hours.

In an effort to speed up this machine's capacity a two-lip, or spade, cutter was installed, and at the same time the coolant was passed through a filter and returned to the interior cut by a 15 hp pump. The new set-up called for production of two pieces in two hours and 10 minutes.

Under the new schedule of operation, coolant temperatures rose to 140F, making satisfactory operation of the machine virtually impossible. At the increased oil temperature, drills had a tendency to run-out, and there was excessive time lost adjusting, backing up, starting again, and changing cutters. This condition existed in the spring with ambient shop temperatures of 80F. Production men realized that the process could not be continued during hot summer weather.

A coolant cooling unit was installed to maintain coolant temperatures at 100F. Enough capacity was required to take up the excess heat created in drilling, the heat generated by the machine tool, and the heat created by the 15 hp pressure pump. After the cooling system was in operation, it was possible to

meet production schedules and produce two pieces in the specified time of two hours and ten minutes. Controlled coolant temperatures made possible higher speed for drills, and run-outs, which had previously caused so much trouble, became a negligible factor.

It should be noted that the optimum temperature of coolant does not necessarily vary with the metal being processed, as the operation is affected by the cutting speed, depth of cut, condition of tool, and other factors.

There are many advantages in selecting a single packaged unit for each machine tool in preference to a multiple system.

1. Capacity of packaged unit is balanced to meet operating requirements of each machine tool.
2. Individual units are completely self contained, with no auxiliary equipment to buy.
3. The packaged unit can easily be moved to a new location when required. This is particularly important because plant re-arrangement is going on all the time.
4. Each unit is water cooled and has ample capacity for satisfactory operation when plant temperatures are high in summer.
5. With individual coolant coolers, short pipe lines between unit and machine tool reduce refrigeration losses to the air.
6. Compressor and controls are fully enclosed, protecting unit from dust and dirt.
7. Thermostat may be set for the temperature required by some particular machine tool. This is impossible with a central station system serving several machines requiring that the oil be at different temperatures.
8. An operating engineer is not required.
9. Individual units have greatest operating economy as each unit may be shut down when machine tool is not in use.

To make an accurate study of increased production, it is necessary that the machine tool be in first class condition and that it meet established production requirements before the coolant mechanism is attached. It is then possible to determine the actual increase in production obtained by the use of mechanical refrigeration.

Because of the many variables encountered in the operation of machine tools, it is often difficult to obtain an accurate picture of increased production.

106 Separate Ventilating Systems for Troop Ships

The 20,000 ton, 600 ft super-troopships now being built by Federal Shipbuilding and Drydock Co. may fit into the post-war plans for the American merchant marine, according to Federal's president, Lynn H. Korndorff. Nine of these vessels have already been completed.

These ships are conventional new troopships in appearance, except for the omission of all portholes. The installation of 106 separate ventilating systems provides for constant circulation and conditioning of air pumped into the ship, with the large number of systems serving as a protection against any serious breakdown.

This ventilation and the lack of portholes would go a long way toward making life more bearable for post-war passenger traffic managers constantly plagued by requests for outside rooms, a steamship official pointed out. On a ship of this type there would be no outside rooms and the absence of the portholes might make for cabins that were square and roomier than the conventional long, narrow staterooms born of the desire to give more outside space.

The super-troopships are also the last word in safety. All-metal furniture is used throughout, and all curtains are of glass fiber—two safety factors that could be applied in post-war reconversion. The ships are even coated with a fire-retardant paint.

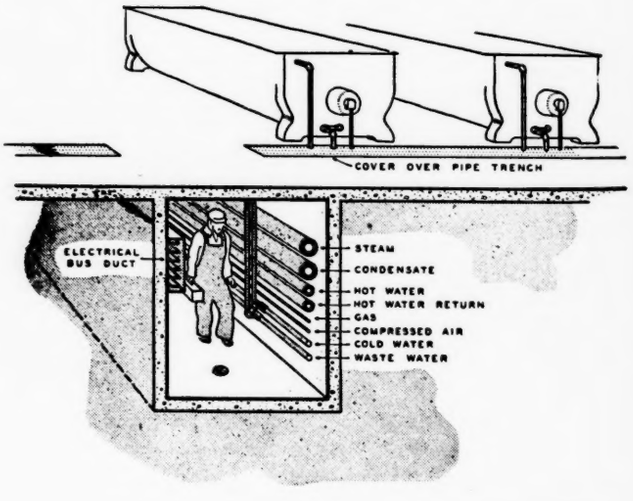
The Factory of the Future

The H. K. Ferguson Company, engineers and builders of industrial plants, Cleveland, has completed and made public a study of a survey of what the factory of the future may be like. The study is broad in scope, represents the thinking and experience of the company's 300 engineers and the industrial executives with whom they come in contact.

Among the subjects covered in the survey was thermal storage using off-peak electric energy stored in large hot water tanks and circulated to the building during occupancy hours.

Piping also came in for consideration and Ferguson engineers propose that the maze of overhead pipes and wiring should be installed in easy-to-service tunnels as shown in the accompanying illustration.

Further information regarding the survey is available from the H. K. Ferguson Co., New York.



Money-Saving Methods for Conserving Fuel

T. W. Reynolds

Practical ways for the operating and design engineer to save fuel in producing heat and other forms of energy in all types of buildings. Although fuel conservation is a constant problem, it is particularly timely now.

HEATING AND VENTILATING'S REFERENCE SECTION

MONEY-SAVING METHODS FOR

It is not the purpose of the suggestions which follow to cover every last point on fuel conservation. Instead, the primary objective has been to lay particular emphasis on ideas which might not occur to the busy engineer or which have not already been treated elsewhere.

Fuel conservation is much in everyone's mind now; it is always important. Therefore material has been included which may not be applicable now but will be in days to come. — Editor

BY T. W. REYNOLDS

WE don't know what hard times are! Some remote and barren fishing settlements do, for they have to begin in June to collect the meager driftwood for fuel in the winter to come. Our grandfathers of the prairies were even less fortunate; they had no wood at all. So for fuel they burned bundles of the long grass, the dung of the buffalo or cattle.

Our very great-grandfathers in Europe dug and cut the earth or sod (peat) of the mucky lowlands, dried it, and then used it for fuel, though there was only 10% of combustible left. Surely they would have rejoiced if but given the opportunity of converting a furnace from oil to coal and back again, not to mention a ration gift of 1½ gallons of gasoline per week.

With such a heritage we should be able to carry on with a little less of something better in the way of fuel than they had, simply by saving each Btu, kilowatt-hour, pound of water, steam, or warm air that it is possible to save. Each of these requires fuel. Each also requires transportation, man and machine hours, money, equipment and materials. These in turn require fuel which, when saved, frees transportation space for the routing of such savings to the points where no savings can be made.

Waste is particularly pronounced in house-heating. In domestic heating there has not been the marked improvement in utilization efficiency that has taken place in industrial and utility practice. For example, the decline in average coal consumption per kilowatt-hour in public ultility power plants has been from 7 lb in 1899 to 1.3 lb in 1941 (some of the most efficient to only 0.8 lb); in 1919, the average coal consumption for locomotive fuel was 170 lb per 1000 gross ton-miles of freight service, while by 1941 it was only 111 lb. Meanwhile, the coal consumption per passenger-train car-mile fell from 18.5 to 14.9 lb, while the coal required per gross ton of pig iron made dropped from 3577 to 2828 lb.

INSULATION TO SAVE HEAT

Insulation, controls, proper combustion are all of great importance, but which is most important as a fuel saver is a question. Probably the relative value of each varies widely with location, type, and condition of building, nature of industry, and possibly the fireman himself. This article will deal with insulation first for several reasons, one being time. Insulation can be quickly installed and without interruption to operation or to process routine. Fuel savings, always important, may not be so important one year from now.

Advantages of Structural Insulation Advantages due to the application of insulation to a structure include: exterior walls warm in the winter with slower cooling, quicker heating (this saves fuel), and reduction of down drafts from the roof and elsewhere; warmer walls and temperatures on winter mornings; freedom from condensation on and within walls; reduction of noise, vibrations and dust; higher humidities; less depreciation of decorations, and a certain amount of fire retardance. From this record, it is apparent that you pay for insulation in various ways even when you don't get it.

Building Insulation and Piping Insulation of piping in or on exterior walls, particularly on the windward side, saves heat and also protects piping from freezing. Thus it becomes possible to make still further heat savings through reduction of inside temperatures to near-freezing temperatures at night or while occupants are absent from the building. Insulated walls also allow lower temperatures to be carried for the same comfort as those without insulation.

Insulation on Steam Pipes On steam pipes, insulation improves the quality of the steam, and on hot surfaces of any kind prevents overheating of the immediate surroundings with its discomfort to the workers. Where this overheating causes discomfort, a fan will no doubt be installed for ventilating purposes. The fan takes energy and outdoor air for make-up which must be heated in the heating season.

Insulation in the Boiler Room Insulation is of great value within the boiler room, yet boiler rooms and overheating are almost synonymous terms; no one has ever been known to go into a boiler room to get cool, and even the engineer stands just outside the door when he should be inside. But a few case histories prove that they can be kept cool. Take one, for example. In this case the following bare hot surfaces were insulated: boiler drum heads, pipe flanges, feed water heater, hot water storage tank, breeching and induced draft fan with its outlet stack up to roof line. Results: Boiler room fans were not required to be run, the formerly underheated factory was heated more satisfactorily, overload on boilers was reduced so that they were operated at a more efficient point and with less maintenance, boilers were repaired less frequently, and personnel was kept contented.

Insulating Process Equipment Like the breeching which was not originally insulated because it did not contribute directly to fuel saving, there are other items of equipment usually not insulated, but where direct or indirect fuel savings could be made by doing so. For example, insulation should be applied to the pipes of dust collecting systems if the dust laden air is saturated with vapor which otherwise would condense in cold weather. Process tanks with open tops should, when on standby, have an insulated cover. Expansion tanks with their connecting pipes need insulation for the purpose of saving heat, and when in the attic space, with the additional objective of preventing damage through

CONSERVING FUEL

freezing. Steam traps are often located in cramped quarters and not readily accessible, so that they are left without insulation, but definitely require it in unheated places to offset the additional heat losses and liability to freezing. Service hot water tanks and piping are often insulated, but usually the circulating lines between boiler and heater are not.

Rechecking What Not to Insulate After checking a plant as to what to insulate, it is a good plan to re-check it on the basis of what not to insulate; in other words, an analysis should be made as to just why any item should be left bare. Discoveries will be made, inconsistencies will be found. Here is a small hot pipe leading to a large uninsulated hot machine. The pipe is obviously insulated, but the machine is of irregular surface and the insulation more difficult to keep in place, so that it is not insulated: yet machine has very much more heated area than the pipe. Here is one building covering one acre of ground and it is without insulation; another covers 50 acres and is fully insulated. To be consistent, only 49 acres of the 50 acre roof should have insulation. To be correct, not even one square foot of either roof should be without insulation.

Checking Insulation Survey of a plant may disclose no bare cold or hot surfaces, yet such a plant may not be insulated to the extent required. For example, a water line may be insulated and also pumped for circulation to keep the water from freezing, though it might be more economical to add more insulation so as to reduce some of the pumping energy. Again, steam pressures and process temperatures may have increased since the insulation was installed, thus requiring a different type or thickness of insulation. If not, has the insulation been installed in an efficient manner, tight to the heating surface, and without distortions? A nice jacket may conceal insulation loosened, shrunk, deteriorated or affected by moisture, water, chemical fumes or vibrations. Metal jackets should be used where the insulation is susceptible to chemicals or mechanical damage, using runways over insulated surfaces wherever a workman is apt to walk over them. Incidentally, a practical test as to proper insulation (in place) for the job is that surfaces should be no hotter than the hand can stand when held on the insulation. Another test is to examine all steam traps to note whether they are overloaded with condensate over and above that from plant equipment.

Refrigeration Piping Insulation Insulating of refrigeration piping and equipment should be done so as to prevent any infiltration of air to within the covering. Moisture will enter a crack and condense, and as there is no heat to drive it out, will accumulate until the efficiency of the covering is gone. either because of soaking or freezing of the interior. It is also important that all hot surfaces in cooled spaces be well covered.

Insulation of Fans and Ducts Air conditioning fans, as well as heating fans, are often left without insulation, because they are difficult to cover. Exhaust fans from hoods over dish washing and kitchen equipment, including the hoods themselves, should be well insulated to keep the heat from the kitchen. Sheet metal of heating and air conditioning chambers require covering from the points where heating or cooling begins, and where outdoor air and return air mix. Sometimes cold air ducts may be found without insulation where run through warm spaces above the ceiling, or where run furred down from the ceiling in cooled spaces. In the latter case at least the top of the duct next to the ceiling should most certainly be insulated. Incidentally, some duct coverings are spoiled by painting. As the paint dries, the material shrinks and pulls away from the cement joining sections.

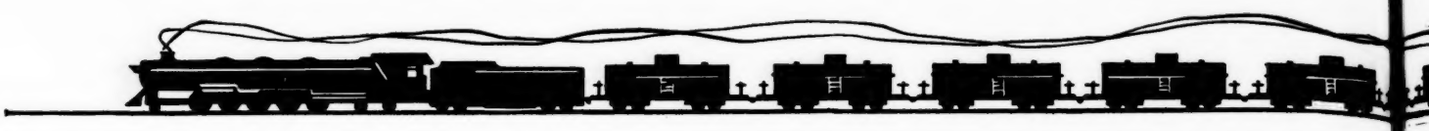
Insulate 85F Rooms When insulating, it is well to remember that any metal too hot to be touched is in particular wasteful of fuel; in fact anything above the temperature of the space wastes fuel, especially so when in an air conditioned space. Accumulations of heat from such sources make for discomfort and usually necessitate the use of fans. An uninsulated surface may waste anywhere from 1 to 35% of heat and power, depending upon its temperature and other conditions. Even dry rooms heated to no more than 85F should be insulated.

Insulation of Pipe Flanges At one time it was quite common to leave flanges, valves and fittings bare. When they were covered it was done more with a view to preventing accidents to workmen when contacting the hot surfaces. Unions are generally left bare on the theory that to cover them conceals their location, yet there are obvious ways of overcoming this. Some specifications still call for pipe covering at flanges to be spaced a sufficient distance from the flanges to permit easy removal of bolts when flanges are opened. The real remedy is to provide removable insulating fittings. Heat is also frequently wasted where sections of insulation are not closely joined on piping or at fittings and specialties. Joints and seams should be well sealed, especially so where the insulation is of the cellular type, allowing air circulation through longitudinal cells parallel to the pipe. Finally, it should be remembered that if it pays to insulate flanges, when they are, say, ten in number, it still pays to insulate a flange where it is the only one around. For example if that single flange happens to be an 8 in. standard flange and the steam pressure is 100 lb, it will lose heat when bare equivalent to at least one-half ton of coal per year.

Look for the Cold Spots Advertising literature on insulation seems to be directed largely for its necessity in our homes, but even where a house is not insulated, some degree of insulation should be done at the places where the most heat is lost. At least a strip of insulation should be continuously applied along the eaves in the attic where sunlight glints through cracks and most of the air leaks occur. Old rugs or what not of storage on attic floors are of help in keeping down heat losses where the attic floor is not insulated. The thin wall spaces at floor beams on the foundation wall where showing in the cellar should be filled in with insulation. In rural areas this is taken care of by packing leaves around the outside of the house.

Attic Floor Insulation When loose fill insulation is applied between attic floor beams, it should not be packed so as to reduce the number of insulating air spaces, yet this is what one acquaintance of the writer's did. He was an engineer, but not a heating engineer; after the workmen left at night, he packed the insulation as hard as he could in every conceivable space, doing a good job of using insulation with the least insulating effect.

Garage Insulation Insulation of the garage ceiling below the house floor will make the floor above more comfortable than is possible by adding radiators to the rooms immediately over the garage. The floor of heated sun porches over unexcavated or open spaces should



be similarly insulated. If the garage must be partially heated, it should be insulated throughout, or at least on the thin or dense wall common to house and garage. Insulating the garage throughout may mean that it will not require heat at any time.

Heat is Heat, Not a Percentage The advisability of insulating a house throughout should not be decided on the basis of percentage in heat reduction which it effects. Heat saved by insulation remains the same in amount whether or not the house is equipped with storm sash and weatherstripping. The percentage reduction may be 40% with insulation alone and 34% with the addition of storm sash and weatherstripping.

Insulation to Improve Steam Quality Reverting back to the industrial plant where bigger fuel wastes occur because bigger things are done, we find a lack of insulation, not necessarily on the structure, but upon the process equipment. Lack of insulation on such equipment is not so noticeable due to the heat liberated from the large quantity of hot material being handled. As a result windows are opened so that cold drafts increase the heat loss from the equipment and often delay or spoil production, especially so where the process requires close regulation of temperature and heat flow. Insulation is of great help in process work in reducing the amount of wet steam. Steam of a poor quality cuts down production efficiency, shortens life of equipment, and makes more difficult the accuracy or sensitiveness of temperature controls.

Aluminum Paint for Jackets If a hot surface cannot be protected by metal jackets against chemical or mechanical damage, it can at least be reduced somewhat in radiation loss by the use of aluminum paint. Quite often a careful study of a process reveals that the temperature of a liquid, fixed years ago when conditions or reasons were different, can be substantially reduced. Savings up to 50% have been made in this way in some processes, particularly so where hot surfaces cannot be insulated in a practical manner.

Industrial Furnaces Some industrial furnaces are operated continuously, others intermittently. The heat continually lost in the continuous type is much greater than the heat required to raise the furnace to operating temperature; the reverse is true of intermittently-operated furnaces. The continuous heat losses can be decreased better by insulation than by increased thickness of brickwork. In like manner, the heat loss due to heating up and cooling off of the intermittently operated furnaces can be greatly reduced by the lighter weight of insulating brick. The heat loss due to heating up is a fairly large amount on furnaces laid up over week ends, in those closed down overnight it is great, and in those heated with each fitting of product and the product removed after cooling it is tremendous.

Insulation in War Plants A fallacy common of late, as some war plants curtail production, is that insulation is of less benefit under falling production rates. This is wrong reasoning, for production may grow or it may slow, while steam distribution goes on forever.

Too Thin Walls on Furnaces Intermittently-operated furnaces are often made with thin uninsulated walls so as to heat and cool rapidly in order to increase output. Unless the cycle is very short, the external surface of the brickwork soon reaches a high temperature with great waste of fuel. Insulation, however, will not prevent the furnace from being cooled rapidly when desired, as cooling by fan blast can be quickly done. Insulation, of course, can be external or internal. External insulation increases the quantity of stored heat and may keep the furnace hot for a long time if properly sealed up.

Insulating Oil Tanks Exterior oil tanks and connecting lines are often poorly insulated, if at all. It is, of course, important that the oil at the burner be held to a temperature at which viscosity will permit good atomization. Usually this is overdone where there is no automatic control; even then the temperatures maintained are generally too high and, in any event, excess heat losses are common in the heating of oil.

In closing this discussion as to insulation, it is well to point out that the industry never before had so much free publicity on insulation and other fuel saving measures. The government is compiling the necessary factual data for fuel conservation literature, which it is printing and distributing in the large way that only the government can. The heating, ventilating and air conditioning industry should follow the lead for benefit now and in the years which follow.

WINDOWS AND CRACKS

Once upon a time in the old country there was a tax on windows for the sake of the levy. In these times, even though we pay a tax on windows in the way of the fuel required to give us heat and comfort, we are a bit short changed on the deal for we never quite get the comfort we desire. Heat lost through the glass is replaced, but the discomfort from cold drafts down the window, air infiltration and body radiation to the glass, continue as before. Most of these disadvantages can be overcome, however, by the use of double glass. In fact, we can now go so far as to replace some of the wall with glass, or all of it for that matter, with hollow glass block, as their heat losses are not much different from those of walls. Such glass is now commonly spoken of as insulating glass.

Insulating Glass Throughout Production of insulating glass on a large scale should make unnecessary the use of windowless buildings. Such buildings did have certain advantages, aside from meeting blackout and war time safety conditions, but after the war their advantages can be realized with hollow glass block or double or triple glass. The advantages of windowless buildings are of course lessened heat losses and infiltration of air and dust due to absence of single glass. Such buildings also have the ability to carry slightly lower temperatures. The warmer interior surfaces absorb less body radiation, while down drafts are lessened due to those warmer surfaces and the absence of infiltration. The job of heating them and with greater comfort is also made much easier. All these advantages, however, can be largely obtained by the use of insulating glass.

One of the things that is going the rounds right now is the parable of the 22 bricks. You would not leave 22 bricks out of a brick house, yet that is the equivalent of the average window crack in the average home having 22 windows. A common brick

including the joint as laid up measures 2 3/4 x 8 in. on the side we see, so that 22 bricks are equivalent to an area of 3 1/3 sq ft, equivalent to a well-opened window. Certainly, we would quickly replace a missing window pane of much lesser area and even tape a cracked pane. All of this brings to mind the complaint once made by an institution that every time the boilers were fired, it had to be done with gas masks. A sizable fee was paid for the advice of an expert on the matter who found that back of the boilers a goodly portion of the economizer setting had never been bricked up, even though this plant was fired for years and was well along to obsolescence. This is fact, not fiction.

Finding Window Cracks Cracks around window sash cannot always be found by the feel for cold drafts or by the fluctuations of the flame from a match or candle, but they can be detected at night by the aid of a helper with a flashlight to shine the light through. Metal window sash is more troublesome, for the parts which meet get deflected, when the house is being built, by workmen hastily latching them at the close of the day. Usually, some debris gets lodged between the movable parts, especially on a stucco house, and the metal cannot help but be sprung when the window is locked.

Locking Windows Locking a casement window will usually decrease the air leakage by a substantial amount, and locking a double hung window, especially one with a large clearance, will as a rule also decrease the amount of leakage, though the locking sometimes pushes the meeting rail members apart, thus increasing the leakage. The leakage around a window depends upon how the window has deteriorated, how the window is closed or fits when closed, whether the sash is short, the meeting rail members warped, the frame and sash fitted squarely to each other, and whether or not the frames are properly caulked or grouted.

Storm Doors and Vestibules Storm windows and doors (tight fitting) and winter vestibules were common in the days when we only had stoves with less heat to save and a cheaper fuel. What little we had we had to save. There should be sufficient space in the vestibule for the storm door to be closed before the next door is opened. Corner stores sometimes have difficulties with drafts when they have a door on each street. Any store with an elevator may have the same trouble. A revolving door should overcome these troubles so only the air within one of its quadrants can enter at a time.

Double Skylights Double skylights are a great fuel saver and stop discomfort from down drafts. They cost less than the first and operating costs of using heating coils. Broken and missing panes should be replaced and the skylight should be locked tight or, possibly, it can be removed and the regular roofing substituted.

Shades, Drapes and Screens At night, shades should be pulled down, and drapes (preferably heavy) should be drawn in residences so as to reduce heat losses and air infiltration and diffuse the drafts. Heavy drapes and curtains should not obstruct the convection or radiant action of radiators. Roll screens at windows should be pulled down for winter season, and even inside screen doors at French doors should be left in place. This prevents radiation of body heat to cold surfaces and stops warm air currents from wiping the glass, while down drafts are lessened and entering air is somewhat diffused. Smoking at the screens will prove the case, for the smoke will pass up along the screens and will not enter the fine mesh. Further proof of fuel saving will be by way of condensation on the window glass. Incidentally, a metal window with diamond panes will frost up quicker than one with rectangular panes, as there is more metal and more metal contact with the glass. This occurs in the writer's home, even though both types of windows are on the same (windward) side of the house.

SERVICE HOT WATER

The temperature of a municipal water supply may range from 72F in February to 40F in February or March. This in itself calls for 40% more fuel in the winter months, assuming water heated to 140F. Distribution heat losses are also greatest in the winter, especially so if there is a circulating line.

Proper Water Temperature The water should preferably be heated to 120 or 130F, though 140F may be necessary for long runs. Above 140F, there is apt to be a considerable precipitation of soluble salts from hard water. Rubber washers do not last so long, water is not so clean, heat losses increase and there is more pipe corrosion at high temperature. For house heating, boiler water must be held at higher temperatures than in the summer.

Reducing Losses A weekly bath of 5 inch depth is considered sufficient in these times by the people of Great Britain. This requires 18 gallons, whereas total immersion doubles the quantity. Hot and cold water should be mixed, not run separately. Hands and dishes should not be washed in running water. Spring faucets will save on water consumption. Thermostatic mixing valves do likewise and add a safety feature. As for faucet leaks, it is well to point out that a home using 50 gal of hot water per day can easily raise the consumption to 65 gal by a faucet leaking at the rate of two drops per second.

Water Hammer Where the water pressures are too high a reducing valve should be used. This will save wear and damage from water hammer on washers and trim of the fixture in use, as well as on the other fixtures, reduce the leakage, stop splashing and save water. Air cushions will help to cushion water hammer and also provide for compression of air within them due to the expansion of water as it is heated. The shut-offs at fixtures can be used to throttle the pressure, but they do not throttle pressure elsewhere in the system. In one case in mind, sudden closing of a kitchen faucet caused a defective plug to blow out of a hot water tank. As the tank was located over an oil burner where it should not be, the escaping water spilled over the oil burner with resulting short circuit of its transformer. A new transformer was installed.

Flushing of Equipment Indirect water heaters, storage tanks and connecting lines should be occasionally flushed out, and thoroughly so. Convenient draw-offs should be arranged for this. In some installations, a second storage tank has been used, though for cold water only. The water in such a tank becomes tempered by heat absorbed

from the cellar, especially if located in a hot place at the ceiling near the boiler or smoke pipe.

Insulation of Lines Hot water lines should be insulated throughout with particular reference to those where run in garage and on or in exterior walls. Cold water lines where concealed also need covering to prevent freezing and condensation. Bare hot water lines will radiate heat to bare cold water lines where run too close together.

Circulating Lines Where there is a hot water circulation line, it should be throttled down or valved off altogether, as such lines are generally wasteful of heat. Water in a pipe only has natural circulation because it is losing heat. Where a circulating line is used it should be carried close to each outlet to avoid wastage in drawing cool water from non-circulating connections.

Small Pipes Cut Losses In general, domestic hot water supply should preferably be piped in direct individual runs of small pipe, say one to each bath room and one to the kitchen. The usual practice has been to run a 1 in. main to the kitchen and take branches from this main to the other locations. Such a system can easily contain two gallons of water which, after fixture use has stopped, is wastefully left there to cool. If instead, ⅜ and ½ in. direct runs of copper pipe were used, there would be less than one gallon of water cooled off and wasted. This also means less time before hot water can be drawn at the faucets. A 1 in. main also has the disadvantage of circulating within itself.

The rate of heat emission per square foot of external surface decreases slightly as the pipe size increases, but the rate of heat loss per lineal foot of the pipe increases because the amount of heat losing surface has been increased. Notwithstanding this greater heat loss, the larger pipe takes longer to cool off due to the larger quantity of heat stored in the greater weight of water and metal of the pipe. Due, then, to this lower rate of temperature drop, there will be less motive head for water to circulate in the pipe, but this is more than compensated for by the lessened resistance per pound of water circulated. The total friction surface in the larger pipe is greater, but the volume of water content has increased at a much greater rate. Therefore, because of the greater influence of some of these factors, the larger the pipe the higher the water temperature that will be maintained, the greater the rate of heat loss and the greater the amount of heat and water wasted once the pipe has cooled down and the cold water drained off to obtain hot water. From this it will be seen that where a circulating line is used, it should be of larger size in order to maintain temperature.

The quantity of cooled water withdrawn and wasted from a larger pipe depends upon the frequency of use. This may, in some cases, be no more than in a much smaller line. After a lapse of time in usage, the water in a small line might have to be fully wasted due to quicker cooling to lower temperatures, but the water in the larger pipe may still be not too low in temperature for use when mixed with a smaller quantity of cold water.

WASTE BY LEAKAGE

Leakage of steam, compressed air, gas, oil, or water from dripping faucets may be fully as wasteful of fuel as lack of insulation. A hole of 1/32 in. diam. in a 6 in. pipe containing steam at 100 lb pressure would in one year waste 2½ tons of coal. Ten feet of this same pipe left bare of insulation would waste a like amount. If the hole mentioned, or its equivalent area in leaks, were in a steam boiler, the leaks would no doubt be repaired. When leaks destroy insulation the fuel waste becomes two-fold.

Causes of Leaks Leaks may be caused by the action of water hammer at joints. Water hammer may be due to uninsulated lines, or improper drainage and grades of piping. Leaks are also caused by unequal expansion of pipes. Branch lines sometimes leak at their junctions with main line due to excess vibrations, improper alignment, or to insufficient allowance for expansion. All the strain is thrown on the joint. Welding fittings in place of flanged valves will eliminate many leaks at joints.

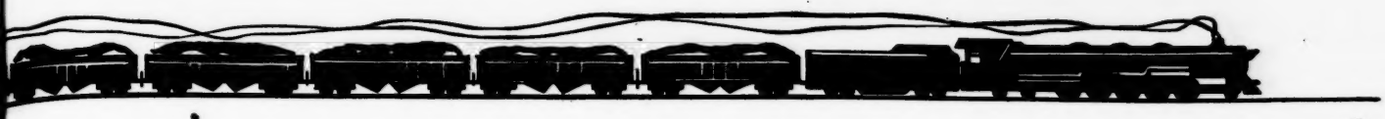
Expansion Joints Leakage is also caused by improperly placed expansion joints and anchors, or because of lack of service to the joint. Proper operation of an expansion joint can be determined by taking measurements at the joint, just before and after steam is in the line. Necessary expansion may be found greater than indicated by the calculations when the job was designed. Indicators fitted to the joint will check its operation from time to time. Properly placed and well-secured anchors will limit movement to the slip of the joint. Pipe bends for expansion purposes should also be checked. They are sometimes limited in action by expansion against some interference before the necessary expansion has finished.

Leaks in Drain Lines Drain lines usually corrode faster than most other pipes. Being under the floor or not readily accessible they are given scant attention. Leaks result. All relief pipes and many drains should have visible outlets. Drain outlets preferably should be near the drain valves. Relief pipe should have unthreaded ends to prevent anyone from capping or plugging them.

By-Passes in Piping Improper operation of by-passes and failure to close them tight is the cause of many leaks. By-passes on stop valves and reducing valves handling steam should be opened prior to the opening of the main valve, so that piping will be gradually warmed and pressures slowly equalized before opening main valves and admitting full pressure. Where there is no by-pass the main valve should be slightly cracked open for a time.

Operations as described prevent leaks from too rapid expansion and water hammer due to excess condensate in cold pipes, especially so at high pressures. They also keep the condensate within the normal capacity limits of traps and drainage system. When a system has been filled with steam at the pressure required, the by-pass should be immediately closed to prevent waste due to building up of excess pressure on the low pressure side of a reducing valve. If it is not immediately closed, it may be forgotten and pass steam in too great a quantity, or be overlooked at some future time when it becomes necessary to close the main stop valve.

Steam Traps Steam traps generally are in out-of-way places. When neglected, they contribute greatly to leakage. By-passes on traps are sometimes conveniences, but they are not always necessary, and once open are usually forgotten.



When the seat of a valve, as in a steam trap, receives some dirt, it cannot close completely, so that it wire draws and leaks. A strainer, if used, would have caught the pieces of dirt. Air cocks on traps are another manually-operated device and therefore often left blowing. They are necessary at times, however, to traps liable to air binding. Air will not condense so as to allow steam to enter the trap.

Sources of steam leaks should be ferreted out when disclosed by an unusual rise in water temperature of the feed water heater to which drain lines discharge. Leakage passed directly by the valve of a trap can be detected by means of a stethoscope when applied to the trap body. In the case of a compressed air installation, check for leakage should await close of production. The compressor can then be shut down at maximum working pressure and all air cocks closed, after which the time taken for the pressure on the air gauge to drop will indicate the extent of leakage.

Other Leaks Leakage of cooled water by faucets or bubblers of drinking water coolers causes increased wear on the compressors and wastes electric energy as well as water. Leakage past boiler uptake dampers results in serious heat loss when boilers are banked. A leaky uptake damper in a cold boiler will reduce the draft and capacity of the operating boilers.

Blow-Off Valves Blow-off valves at boilers frequently waste steam to the sewer. Leakage can be detected by feeling of the blow-off pipe. If hot, the valves should be repaired. The valve next to the boiler can be kept in good condition by using the outside valve for blowdown. Radiator valves, closed when hot, sometimes contract as the system cools, and then leak when steam is again in the mains. If the system is one-pipe, such valves will cause trouble. Valves on piping should not be used for throttling as they will wire draw and eventually leak.

HEATING SYSTEMS

The need for controls for zoning heating and for many other purposes is apparent to nearly all of us, though there are still many places where they should be more widely used, as follows:

Controls and Stair Wells Stair wells have a lot of glass and large radiator capacity; these, however, can be valved off, unless they are needed to keep sprinklers from freezing or for any other water piping which cannot be piped elsewhere. Stair wells are usually overheated, especially so in mild weather, and often at the top of these flues the windows are opened. Controls would limit this waste, particularly so if used on any of the radiators near the top where the heat accumulates. Similar treatment should be applied to pent houses with their relatively large amount of thin exposed surface. Door checks should also be used for pent houses, as such doors are often found partly open and sometimes wide open, due to the force of the wind. Show room window enclosures could also use controls.

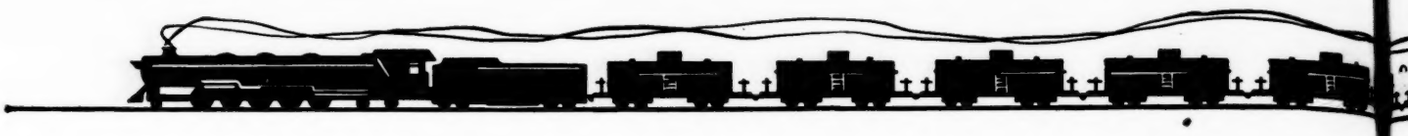
Controls for Roof Tanks Heating piping to water tanks on the roof should be automatically controlled so as to heat only when outdoor temperatures are near 32F; even at freezing point, heat may not be needed, for considerable latent heat has to be given up from the stored water before freezing will start at the top and along the exposed surfaces of a tank.

Seldom Used Spaces Heating of fuel oil should be under thermostatic control. Steam piping left bare for heating of spaces may overheat these spaces in mild weather. Such bare piping only adds heat to high levels, and since it is not subject to controls, should be insulated. Less radiator surface is needed in public halls where people wait in street attire, or else hall windows should be permanently locked and radiators provided with controls. Recirculation of hot water should be avoided to wash rooms in remote locations. Separate heating may be more advisable. Wash rooms with practically continuous usage do not need recirculation. Some boilers, particularly those in churches, have too much grate surface. This can be reduced by filling in at rear and sides with firebrick.

Pipe Coils in Industrial Buildings Quite a number of industrial plants built years ago are still wastefully heated with pipe coils. Such coils are usually very long, so that some part or one end of a coil is hot, the rest cold. They are not suited to automatic control, not even manual control, for they cover too much space to be without heat at a time. If placed on the ceiling they waste heat to upper areas, the roof, or to an unheated storage space on the floor above. Radiant heating of industrial buildings offers fuel savings where frequently opened large doors make slow heating of the cold air after the doors are closed. Hangars, garages, shipping platforms, and like spaces should find radiant heating of special value, as there is no need to lose heated air each time the doors are opened. Old type warm air or hot water heating systems which depend on natural circulation are also wasteful of fuel. Such systems are inherently sluggish and have larger radiators and pipes, therefore do not respond readily to automatic control.

Unit Heaters Unit heaters overcome the difficulties often encountered with direct radiation of too much heat wasted in one place, not enough heat in some other place. Unit heaters place the heat where wanted, also when wanted, if automatically controlled. They give best results in buildings of moderate ceiling height. For high ceilings and long blows, direct-fired heaters can be used. Energy used by the fans should be taken advantage of by maintaining maximum heat transfer, therefore supply pipe should be taken from the top of the main so as to eliminate wet steam as this reduces heat transfer. In mild weather, fans on unit heaters are often stopped, but the steam kept on. This is wasteful, particularly so as the heat is no longer brought down by the fan to the occupied zone.

Location of Unit Heaters Arranging unit heaters so that they blow along cold outside walls or glass may in some cases use more heat. Where the workers are at benches along outside walls, this method may have the further disadvantage of blowing too much heated air on the workers. If the thermostats are then set for lower temperatures, the interior of the structure will probably be too cold. It is of interest to note that one industrial plant makes good use of unit heaters to avoid heating of certain areas where heat is infrequently required. This plant uses a few portable unit heaters which are wheeled around to any area when it requires heat. Steam mains are arranged for this with outlets for future connections.



Belts on Unit Heaters Belts on blower-type unit heaters should be inspected every three months for looseness, though some slack should be left to prevent noise, excessive wear and undue load on fan and motor bearings. Sheaves on fan and motor should be properly aligned. Fan bearings should be oiled at regular intervals.

Globe and Gate Valves Authorities have stated that the drop in pressure through valves and fittings is some constant (K) multiplied by the velocity head. If K is taken as 100% for globe valves, then K for gate valves is only 1.9%, 50% for angle valves and 9% for standard elbows. From this it will be seen that globe valves should be used only where flow must be regulated in amount or pressure.

Globe valves can throttle down to a tiny trickle, and can be quickly operated and repaired. Their great resistance to flow is due to change in direction of flow through their bodies. A gate valve has straight way flow, should be either wide open or fully closed, cannot throttle flow to any extent. Such valves should be used for complete drainage of piping and especially where least pressure drop is important. Check valves have but little flow resistance when of the swing type; when of the lift type they offer considerable resistance. A check valve installed at the discharge end of a reciprocating pump will waste quite a bit of energy if it leaks.

VENTILATION SYSTEMS

Much of the ventilation in industrial plants would not be necessary if overheating were prevented. Internal heat loads of many plants are very high, particularly so in windowless structures. In others, the direct and indirect radiation are so out of balance that overheating starts as soon as the fans are stopped. With gradual increase in exhaust requirements and with make-up air provided only by infiltration, radiators were added from time to time, thus producing the condition cited, if it did not already exist in the original design.

Heat from Goods in Process Hot forgings in one war plant were removed from one room to another for lack of space. The first room then became underheated, the second room so overheated that fans were installed to remove the heat. Another plant made good use of the heat from process materials. In this case, hot shells from a heat treat furnace were run around on a conveyor before going to the next operation, in this way heating a previously underheated area and not overheating the area where the next operation took place.

Small Fan for Partial Load Engineers sometimes design under pressure of limitations in first cost, rather than designing primarily for economy in operation or greater fuel economy. Thus, in an auditorium, one will often find a single fan capable of ventilating a crowded house, though at times only ten per cent of seating capacity may be present. A second fan should have been installed for greatly reduced ventilation loads, or perhaps no fan at all is required at such times. Generally, too, in many plants, the rate of total air circulation is more than necessary to distribute properly temperature, humidity and sufficient oxygen for dilution of accumulating impurities throughout the conditioned space. Upon occasion one will find two fans so arranged that the air flow to or from one is opposing the air flow of the other, thus wasting power.

Low Fan Speed vs. Dampers Free discharge from a fan takes power as the cube of the speed, otherwise by the square of the speed. Consequently, fan capacities should be cut by running them slower, rather than by the use of dampers. Incidentally, the control range of a damper lies only within a narrow amount of movement at one point in the setting. If someone would design a duct damper with equal control for equal movement, he would contribute a valuable aid to the balancing of ventilating systems. Frequent damper settings and velocity ratings are necessary as it is now, back and forth too much or too little on a point, until a near satisfactory adjustment is made.

Using Boiler Room Heat To reduce the amount of cold make-up air in industrial plants, it may on occasion be possible to provide tempered make-up air to boiler rooms from adjacent factory areas. In other cases it may be practical to reverse the procedure by discharging the excess heat of a boiler room to some nearby space requiring heat or make-up air. Make-up air has even been introduced in some spaces without heating at all, simply by introducing it through a type of overhead circular air diffuser which diffuses it well up horizontally along the ceiling, but which in the non-heating season can be quickly adjusted for downward flow to the occupied level.

Propeller Fans The propeller type of fan is often used for general ventilation of a space, though not to good advantage where there is no provision for make-up air. Several small fans are better than one large one, serving better to confine ventilation to the spaces required so that less total air is moved, especially so as all spaces do not always require ventilation at the same time. The length of ducts connected to such fans should be limited and they should be of large size, free from leakage and provided with turning vanes in elbows, avoiding elbows where possible. The flue effect of interior vertical risers is of some help to this type of fan.

Roof Ventilators Power roof ventilators should preferably have dampers which automatically close to shut out downflow of cold air, particularly if other fans are still exhausting. Some types of these ventilators have few restrictions as to discharge and blow the air up well above the roof level to avoid recirculation to other fans. Power-driven roof ventilators waste energy and produce no satisfactory results if windows are opened above a level of 10 ft from the floor. Sometimes sawtooth skylights are opened and the air then shortcircuits from these openings to the roof ventilators.

Exhaust Hoods We can't get along with air or without air. It is needed for ventilation and combustion, but it also makes cold drafts, stops circulation in radiators, often gives too much excess of air in a furnace, and must be moved in order to remove odors and fumes from a space. Therefore, as a material handling device a dust collecting system is not a very efficient method of transport. The quantity of air moved depends upon its velocity, which in turn depends upon the kind of gas, odor, or material moved. Using as little air as possible saves power and the heating or cooling of make-up air from outdoors.

Hood Design The closer the hood is fitted to the point where a nuisance is generated and the better the design of the hood, the greater the amount of dust, vapor or fume removal, and the less air required to do the job. Experimental hoods cost something, but they pay dividends as the air velocity outward from suction hoods decreases approximately with the square of the distance. A study should be made to see if it is not possible to reduce the amount of nuisance created by the process. Sometimes materials that require a high velocity for complete removal from a system settle out of the air streams at cleanouts installed at turns when lower velocities are used.

Use Air Changes with Judgment General ventilation requires too much air for adequate dilution of a nuisance in a larger space, yet sometimes it is required. Another disadvantage of general ventilation is that engineers usually think of it in terms of so many air changes per hour, regardless of the area or height of the space. Upon calm reflection, it is obvious that an air change of five with a 45 ft ceiling is just as much air moved as with fifteen air changes where the ceiling is only 15 ft high. In computing air change, why go beyond the occupied zone of, say, 10 ft above the floor?

Unit vs. Central Systems Present production practice necessitates frequent change of plant layout, manufacturing methods or machine locations. Several small exhaust systems may therefore be advisable, each exhausting from a group of machines, all of which can be more readily relocated and with ducts more apt to be salvaged than would be the case with a large fixed central system. This method has the further advantage of operating less hoods when only a few are required, therefore keeping the suction steady at all exhaust inlets. Where a common exhaust system is installed, it can be better balanced by centralizing the fan with respect to the larger hoods. Runs of piping should be short, as few bends used as possible, and leakage points should be eliminated by proper repair.

Operating to Aid Hoods The canopy type of hood is used where vapors rise naturally and velocities in such cases can be low. Doors and windows should not be opened so as to create drafts which will allow dust or vapors to drift away from hoods, thus increasing the concentration and the need for fans in the general space. Enclosures as required in some processes are kept under suction to prevent exfiltration from the enclosure, the fans merely handling the inward leakage. This leakage is often greater in amount than required for the purpose. Compartments and enclosures should be limited in size to the bare housing of the process equipment.

Kitchen Hoods Kitchen hoods do not require face velocities in excess of 100 fpm per sq ft. Those for steam tables and dish washing can be reduced to 60 or 70 fpm. Too high a velocity pulls the steam vapors out so fast that they condense in the hood and drip over everything below. Sometimes a double duct is required to prevent condensation on cold metal.

AIR CONDITIONING

Air conditioning for precision production saves fuel by increasing output in two ways. Spoilage is reduced while labor output is increased due to greater health and comfort. It may be possible, however, to reduce the amount of air conditioning in some cases for the duration of the fuel emergency. It can be eliminated from non-process areas and from some processes. Usually either the temperature or humidity or both need not be held so low in the cooling season. Throwaway air can go to the toilets, locker, and wash rooms by way of louvers in doors to these rooms.

Heat Gains Heat from process should be captured immediately, all heat appliances well insulated. The conditioned space should be fully insulated, possibly provided with a false ceiling. Windows and skylights may be blocked up, painted, reduced in area or shaded with sun shade screens, blinds or awnings on the east, south and west sides.

Use of Well Water If well water is used for building service and for process, it may be more economically arranged to pass first through cooling coils for space conditioning. Well water may also go direct from building service, process or cooling coils to roof sprays. Some installations cool condenser water in roof ponds. Sun load with an insulated roof is only a small portion of the total air conditioning load in blackout buildings with their high internal heat load. A tremendous quantity of piping and water is required for complete coverage. The water requires energy to get it up there.

Duct Leakage Ducts should be checked for leakage of air in furred spaces, relief and back draft dampers to see that they are not set to open too freely and outside air damper should be checked for minimum setting. This damper can often be closed at night and should be closed in the heating up and cooling down periods for quick results and for heat and energy savings. Where a return air fan is not installed, any increase in recirculation adds resistance to the return of air, so that more outdoor air may be taken in than required.

Reheat in Air Conditioning Reheat in air conditioning cannot always be avoided and often cannot be offset by some method which will avoid any increase in the refrigerating load due to reheat. The run-around cycle for reheat adds only the energy required by a small pump for circulating water from pre-cooling to reheat coils, but because of the pumping charge the reheat should be kept to a minimum. Sensible heat withdrawn from the warm air by the pre-cooling coils is circulated to the reheat coils where it is added to the flowing air. Reheat as obtained from excess exhaust steam is another economical means. Reheat may also be obtained by introducing the supply air first over sources of heat which must be cooled.

Starters and Switches Electrically - operated machines should have conveniently located controls for starting and stopping, such as push buttons and foot operated switches. Speed reduction should be used for throttling down centrifugal pumps, rather than doing this by valve closure, otherwise power is wasted. Dampers used for the same purpose with centrifugal fans also waste power. Pumps with excessive packing pressure require considerable excess energy.

Lighting Load Once a place is air conditioned, it is doubly important that all lights be checked to see that they are no larger than necessary. The heat contribution from lights is so well known that some greenhouses, such as in

the Boyce Thompson Institute for Plant Research, Inc., have thermostatically-controlled lights as the only means of heating, the primary purpose, however, being to increase the number of light hours for growing plants. It is thought that the radiant energy of lights, as in a motion picture studio, make it possible to carry lower temperatures in such places and that the effect may be even noticeable in other places, particularly so when ceilings are rather low. The heat from large banks of lights and any high level of illumination, as in display windows, should be captured by exhaust ventilation before it escapes to air conditioned spaces. Fluorescent lights reduce not only the power load, but also give a 37% decrease in radiant energy from that of incandescent lights.

INDUSTRIAL PIPING

Coils vs. Steam Jets There has been considerable discussion of late regarding the best method of heating liquids, as to whether this should be done by steam coils immersed in the liquids, or by steam blown directly into the liquids. In theory, steam jets give the highest efficiency, because they give up the total heat of the steam to the liquid. Since the condensate is not returned, pumping energy is saved and there are no heat distribution losses which may be appreciable on a long return. Practically, however, jets are more apt to overheat the liquid and the temperature of the liquid cannot be held as steady at the point required. Moreover, steam is quite liable to escape through the surface of the water, especially where the steam travel is short, as in a shallow tank and with steam superheated. Under other conditions, the steam might have a chance to condense before reaching the surface of the water. Obviously, the steam pressure at the tank inlet must exceed the hydrostatic pressure above it in the tank; in fact, if otherwise it would draw back liquid from the tank.

Steam injected into a liquid also creates water hammer and adds water which may be wasted through the tank overflow, though it is possible to eliminate the water hammer by using a perforated conical nozzle on the end of the steam pipe. In the final analysis, this method is objectionable, if for no other reason than that of causing all of the troubles and waste previously enumerated when make-up water is added in an appreciable quantity to a boiler. With a steam coil, the trap draining it can be adjusted as required to hold the condensate back as the liquid temperature rises to the desired point. The resulting waterlogging of the coil reduces the effective heating surface of the coil, the liquid is then less apt to boil away, less steam will be condensed, and the condensate will be passed at a much lower temperature.

Advantages of Superheat Superheat may not give any substantial increase in boiler efficiency, but may add some capacity to a battery of boilers to meet peak loads. Superheated steam is used primarily for power purposes, to reduce cylinder condensation and erosion of turbine blades. An incidental advantage is less wear on valves and fittings. Use of superheat does imply lubrication and therefore makes more difficult the maintenance of clean exhaust steam required in some process work.

Superheated steam contributes very much to fuel savings when used for power purposes. It does not save fuel in processing; in fact, for such work it is often undesirable. For the same pipe size, heat distribution losses would be about the same as with saturated steam, but condensation would be less, so that fuel is saved where the condensate is not returned to the boilers. Of course, smaller pipes can be used with superheat, as velocities can be increased due to its greater heat content and allowable pressure drop before condensation takes place. Superheated steam can be transmitted in long runs to its destination without condensation.

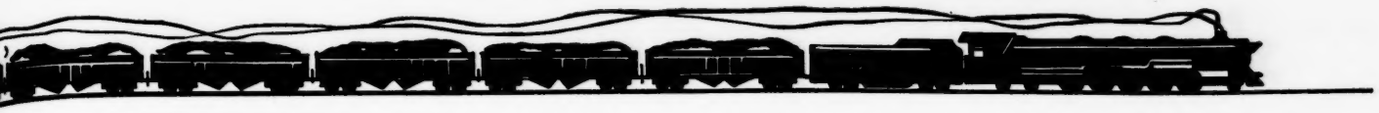
Reduction in Steam Pressure Heat losses in steam distribution systems may be lessened by a reduction in the pressure at which the steam is distributed. This is true even when the piping is increased in sizes for the greater volume of steam at lower pressures. Heat losses from distributing pipes may occur outside of a heated space, or inside the heated space usually at a location or elevation where the heat cannot be utilized; actually the heat losses may overheat some part of the space all or a part of the time. Under some conditions, the fuel saving may not be appreciable. For example, with a distribution system at 160 lb, receiving steam through a reducing valve from a 190 lb 500F plant, a reduction in pressure of 15 lb would only lower the steam temperature 4F.

Reduction of pressure would in some cases reduce the capacity of certain steam utilizing equipment. Equipment of this kind might have to be increased in surface, though this is often worthwhile, for the radiation losses would then decrease, not only from the distribution piping, but also from the equipment. A further advantage would be a lower temperature of condensate as it leaves the equipment. Pressure cannot be reduced at the boiler itself, if its tubes are not large enough to pass the increased volume of steam at lower pressure without priming or carry over. If the tubes are large enough to prevent this, then there will be a fuel saving, for the lower the temperature in a boiler the more heat absorbed by the water from the gases.

Waste from High Pressures Higher pressures require more equipment, such as flash tanks, to recover the heat in the flash and retain the same economy. Higher pressures also increase the quantity of leakage from a system. For example, an aggregate of leakage equal to one square inch with an absolute pressure of 175 lb would release a flow of 2.5 lb per second, but if the pressure were reduced by 15 lb this flow would be reduced 8%, or to 2.3 lb. Still another example of waste due to higher pressures is where the flash or re-evaporated steam cannot be fully utilized. Thus, with steam at 100 lb pressure, the condensate temperature will be 338F and this condensate when passed through a float or bucket trap will cool to 212F at atmospheric pressure, the flash amounting to 12½% of the heat which then goes to waste. If the pressure were reduced to 50 lb the waste would be reduced to 8.7%.

Flash Steam Used in Series Steam contains more total heat and less latent heat at a higher pressure than at a lower. When the condensate is discharged from a steam trap to a point of lower pressure, this excess of heat evaporates some part of the condensate into steam at the lower pressure by changing some of its sensible heat into the latent heat of steam. Flash is immediate and by self evaporation.

Great savings in fuel can be made where it is possible to use this flash steam in multiple evaporators in series from one evaporator to an-



other. sometimes as many as six, in each the condensate flashing at the ever decreasing lower pressure. The number of evaporators or flashes is more often limited only by the cost for increase in heating surface of the evaporators as required by the lower pressures. When steam is flashed in series it is not likely to be held as steady. The amount of flashing will therefore vary. A common supply main for all units will overcome this condition.

Low Pressure Flash Steam Flash steam which becomes too low in pressure for further use as steam can in some cases be advantageously raised in pressure for re-use by the injection of high pressure steam, where steam is available at the higher pressure. Flash steam, or exhaust steam, sometimes cannot be raised in pressure without raising the back pressure too high for drop hammers, or other equipment. This may make it too low in pressure for circulation to remote parts of a heating system. In such cases, it can be used to heat water in a heat exchanger and the hot water can then be pumped to the distant points for heating.

Condensate Meters Help Correct usage of steam involves more than a knowledge of its physical properties. Where evaporation is by steam, its latent heat should be wisely used. This latent heat is often the by-product of power which converts the sensible heat into mechanical energy and rejects the latent heat. Use of a few condensate meters on the processes around a plant will give much informative data. Such meters can sometimes be obtained on a rental basis.

Flash Tank A common way of utilizing the flash from condensate is to evaporate it in a flash tank at a lower pressure. The flash then goes to the low pressure system, or to equipment which can use low pressure steam, that portion of the condensate which does not flash being returned from the tank to the boiler plant. For example, if 26 lb of condensate at a steam pressure of 100 lb absolute entered a tank open to the atmosphere, there would be an excess of heat over that of the atmospheric pressure of $26 \times (1187 - 1150) = 962$ Btu. Since this is about equal to the latent heat of steam at atmospheric pressure, it would evaporate one pound of condensate into one pound of steam at atmospheric pressure. The balance of 25 lb of condensate would then be returned to the boiler plant.

Recovering Heat in Blow-Down Continuous blow down systems from boilers have been arranged so that practically all of the heat in the blow down can be recovered by flashing in a tank and the condensate then passed through a heat exchanger. The only heat wasted is that corresponding to the thermal difference between the incoming cooling water to be heated and the blow-off water going to the sewer. If the boiler make-up water is at a temperature of 60F it can be heated to 66F with blow-off water going to the sewer at 70F. This is a sensible use of both sensible and latent heat.

Size of Flash Tank The size of a flash tank can be determined on the basis of a velocity of flash steam in the tank not greater than 10 ft per sec. Another rule is that the pounds of steam disengaged or flashed per square foot of water surface in a tank is equal to three times the absolute pressure per square inch on that surface. This formula, as used by the makers of steam accumulators, gives a much larger tank, because it takes no account of the amount of the flash surface in the broken up stream of condensate entering the tank.

Full Use of Mechanical Process Some drying processes require drying first by mechanical action, such as obtained by a hydro-extractor or by squeezing the substance through cylinder rolls. Final drying is by application of heat. To reduce the amount of this heat, as much moisture as possible should be removed during the mechanical action.

Operation of Furnaces Industrial furnaces, particularly those that are electrically heated. should be run at full load and not be operated for occasional jobs. Leaks in brick work should be repaired as excess air reduces the temperature of the flue gases and the heat transfer. Process heat is often left on long after it is no longer required. Where gas is used, it should be turned down as the process is completed.

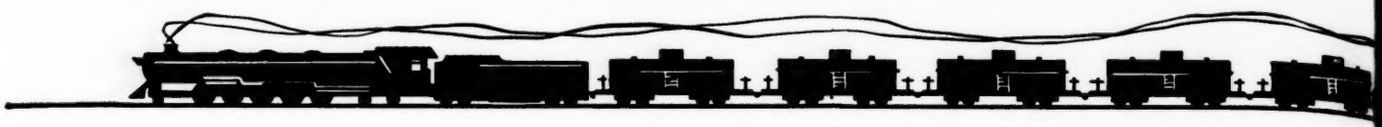
Plan Routing to Save Heat Process material, due to delay or a well planned routing in handling frequently has to be reheated several times in going from one process to another. Unless the heat given up by the equipment and material can be utilized for space heating, the spaces become overheated and ventilation is required even in the winter months. Additional ventilation will under any circumstances be required in the summer months.

More Controls for Process Equipment Open windows and doors, especially on opposite sides of the building, create drafts which increase heat losses at furnaces and other process equipment and may slow up or spoil production. More use should be made of temperature controls in drying and other processes to maintain constant conditions and uniform product. Air binding in steam-using equipment should be eliminated. Even 1% of air mixed with the steam may reduce the efficiency of such equipment by 10%. While condensate normally collects at low points, air collects at high points.

Don't Exhaust Usable Heat Process equipment should be centralized where possible and located in partitioned off spaces to reduce ventilation requirements and the effect of drafts. Many processes develop a lot of heat or gases which could be utilized. When the flames light up the sky momentarily at night in some industries, one may wonder why they could not arrange to make a supplementary product which could utilize that heat and undersell competition, since the heat is free.

See That Steam Is Dry When heating liquids it is important that the steam be dry and that there be no air binding to reduce steam temperatures and heat transfer with resulting spoilage in production. As steam gives up its latent heat of condensation, it leaves an insulating film on the metal. If the steam already contained water, matters are worse; furthermore, the water in the steam does not give up latent heat. Such steam is normal as to sensible heat, but short on latent heat.

Heat Exchanger for Condensate Careful investigation will often disclose a possible economy by returning condensate to the boilers even when the return is from a distant point. If the condensate is corrosive, its heat can still be utilized by a suitable heat exchanger. In this case, the condensate should be around the outside of the coil in the exchanger, so that any corrosive action on the coil can be observed as it occurs.



Advantages of Condensate Return Return of condensate reduces the amount of boiler retubing, number of blow downs, cost of treating make-up water, and amount of scale and carry over. Water is also saved and the feed water is made hotter, so that there are less temperature variations in the boiler. Pre-heating feed water removes impurities and reduces the amount of sludge and other deposits within the boiler.

Mixing to Reduce Temperature If the condensate is too hot (160 to 170F) for the boiler feed pumps to handle and the head from the feed water heater to the pumps cannot easily be increased, then the temperature of the condensate should be reduced by mixing it with cold water, assuming that the additional make-up water is required. It may also be reduced by extracting the excess heat through some heat exchanger prior to its return, or in some installations a new feed tank can be installed at a sufficient elevation to return the condensate. Process provides a lot of condensate, but fortunately as a rule it also requires heating of water and other liquids. When condensate is used for heating hot water supply, the supply and demand should be about equal. Too much storage of hot water in a tank allows time for cooling of the stored water which first must be used while hotter condensate is returning and being wasted to the sewer.

STEAM TRAP POINTERS

Select the Proper Trap Traps are not designed for every service and operating condition likely to be encountered, though they are often selected as though they were, seldom inspected, and are usually left alone until trouble develops. Traps vary in advantages and disadvantages in accordance with their application. A good trap for one installation may prove poor in another. Some are not suited to high pressures or to superheated steam, others are not intended to be used where their mechanism is liable to damage from water hammer, vibrations or pulsations. A particular type of trap may not readily pass air and incondensible gases, may not be good at peak loads, may hold up condensate, or it may discharge condensate at steam pressure, so that re-evaporation takes place at its outlet. There are traps with complicated mechanisms frequently inoperative, some that do not respond readily to fluctuations in flow or pressure of condensate, and others that wear rapidly or lose steam more readily according to load. A trap which closes at steam temperatures will close against air at the same temperature. When steam is first turned on, a trap must handle large quantities of air. The trap should be selected to work satisfactorily with expected conditions.

Traps for Exact Control A trap should have practically continuous discharge if the process requires very exact temperature control. Operation at infrequent and lengthy intervals of time will drop the steam pressure within the process equipment while the trap is discharging. At the same time, thermostatic control may throttle the steam control valve, so that not enough steam can be passed to replace the steam used up by the discharge. Continuous discharge requires smaller orifices which are inadequate at heavy loads. Larger orifices would pass steam on light loads. With other processes, the retention of condensate within the equipment until it has given up some of its sensible heat will save quite a bit of fuel and give less choking effect due to less flash at the trap outlet.

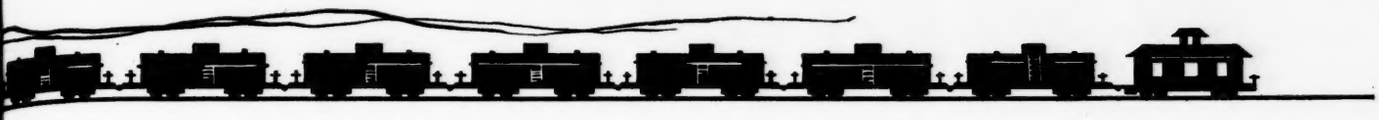
Trap Capacity The capacity of a trap is determined by the area of its discharge orifice, the pressure of ejection, and the pressure discharged against. Low pressure traps should have proportionately larger discharge valves than high pressure traps. At the lower pressures, the differential pressure across the trap for discharge is less, furthermore, the condensate handled is greater and the steam is closer to the point of condensation. For example, at atmospheric pressure the latent heat is 85% of the total heat, at 100 lb absolute it is 75%; hence the amount of condensate per pound of steam is in the same proportions. Before condensation takes place only 15% of the heat will be given up at atmospheric pressure, whereas at the 100 lb pressure it will be 25%.

Condensate Lift A trap does not lift condensate by itself. The differential in pressure at the trap discharge valve does this. It is customary to figure 2 ft of lift for each 1 lb of steam pressure at the trap (theoretically the lift is 2.3 ft) to allow for friction of the piping. From this allowance, there must be a deduction for the equivalent lift for any back pressure or steam pressure discharged against, or a subtraction for the equivalent lift for any vacuum. If the condensate has to be discharged to a higher pressure, the differential is in reverse, hence a pump or pumping type of trap is required for such a condition.

The foregoing comments are only rules for rough selection of trap capacities; precise selection should be left to the manufacturer of the trap. Actual capacities depend on many other factors, such as continuous or intermittent discharge, the area of the valve seat and the temperature of the condensate. Is the type of trap one which retains the condensate enough to cool somewhat, or does it discharge condensate at a temperature close to that of the steam, in which case the immediate flash at the trap outlet will choke the discharge orifice and also reduce capacity due to the steam pressure of the flash. This is particularly true if the trap is of a type that does not give a continuous discharge.

L. P. Trap for Low Pressure A low pressure trap may not work well if used for high pressure, unless the leverage is altered so as to give more power, or the area of the discharge valve made smaller, if it is too large. A trap will not work as well when located at the top of a riser, as steam will leak past the condensate in the lower part of the riser to reach and prevent opening of the trap. In this case, the larger the riser the more there will be of such leakage.

Size No Indication of Capacity The capacity of a trap does not increase in direct proportion to any increase in pressure differential, nor is its capacity based upon the amount of cold water it handles. Body size or size of pipe connections have nothing to do with its capacity, as evidenced by the rated capacities of traps of all makes, which for like capacities and pressures have different sizes of pipe connections. The capacity for which the trap is selected should take into account variations in steam pressure. Another factor is the peak load, which usually occurs when starting up and, unfortunately, at a time when maximum condensation drops the steam



pressure to its lowest point. Consideration should also be given to the much lower steam pressure, actual and not assumed, which prevail in the steam using equipment rather than those in the steam main. Density of the fluid passing through the seat orifice is another factor. This density is not the same as that of the condensate in the body of the trap. The trap should not hold up condensate by being too small, neither should it be so large or so adjusted that on normal loads steam will wire-draw on the valve seat. Erosion due to this or to steam passed through faulty trap adjustment will start leakage which will continually grow larger.

Overloading of Trap A trap once proved satisfactory should not be condemned. It may become overloaded by the continual connecting to it of additional drains. In this case, the by-pass should be opened just enough to do the additional work required until such time as some of the drains can be piped elsewhere, or a new trap of larger size installed. Otherwise, at lighter loads, the by-pass will deliver too much steam, even though the by-pass valve is frequently throttled in accordance with fluctuations in flow. Other remedies for this situation may be a new discharge valve of larger size or an enlargement of the discharge orifice, providing the float has sufficient leverage or power for the larger orifice. Incidentally, reseating the discharge valve or any adjustments made while the trap is cold may shorten the valve stem so that the valve stops just short of its seat.

Watch for Freezing Traps should not be in locations where any necessary heat radiation is wasted, or where it may freeze. A frozen trap will waste a lot of steam. If necessarily exposed, the trap should be well insulated. Some traps are self-draining when cold. All steam lines should be properly graded to prevent accumulations of condensate from being picked up occasionally from low points or pockets, as such accumulations may damage the trap by water hammer.

Use Traps to Avoid Steam Waste Waste due to improper use and abuse of steam traps is tremendous. Little consideration is given them. Some plants have but few drip points trapped. For example, there is a railroad roundhouse where a stop valve is cracked for use as a reducing valve, the steam flowing at fairly high pressures to pipe coils for space heating; each pipe coil has a return connection terminating in the ground outside the building. The condensate is wasted, but the steam is not passed, due to the resistance of the earth. This railroad can get all the coal it wants, but the maintenance department is allotted no funds for traps. Some traps are used, but these are removed from cars in for repairs. Replacement of the removed traps is not hard to obtain as rolling stock must be maintained.

By-Passes a Source of Waste Pet cocks and by-passes on steam traps should be used only when necessary. They are frequently left open, so that wherever possible they should be removed. A plug may take the place of the pet cock. Blowing steam may be detected by watching the sight glass, or by a stethoscope. Waste due to the passing of steam whenever condensate is discharged can be determined by immersing the trap discharge pipe in a pail of water. The weight and temperature of the water are then recorded before and after trap discharge. The rise in temperature of the water should not exceed that due to the heat of the liquid as given in the steam tables for the indicated pressure at discharge. Steam leakage reduces return line capacity, especially so in vacuum systems. Strainers will prevent dirt from reaching orifice seats and will therefore avoid leakage.

Multiple Traps for Multiple Fixtures A single trap for a group of fixtures of sufficient capacity for all will be insufficient insofar as effecting complete drainage of all fixtures. If they are process fixtures, they may each be at different stages of the operation, or starting or stopping, so that the rate of condensation and therefore pressure within the fixture varies one from the other. The one near the end of the operation will have highest outlet pressure and pass steam to close the trap, waterlogging the fixture just starting its operation at the time when it is condensing at the highest rate. Waterlogging will then lower the temperature of the equipment and slow or spoil the process.

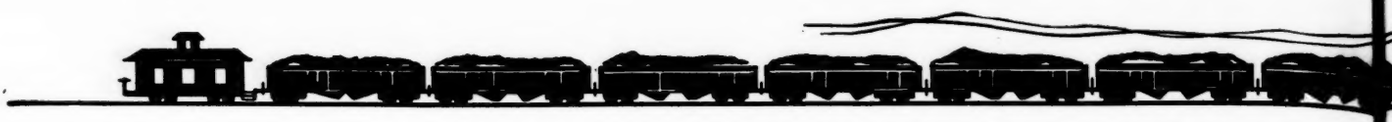
For good drainage, conditions in the return line must always be one of lower pressure than within the fixture. This can be accomplished only by separately trapping each fixture or condensation point. A good illustration of this point is where a single trap takes the condensate from a steam line to a fixture, as well as the condensate from the fixture. In such a case, condensate and air will be held up in the fixture. Incidentally, where abnormal quantities of air must be handled, the trap should be oversized. A valuable piece of equipment should never be controlled by an undersized trap, merely because this trap can be bought at a saving.

LOAD PEAKS AND VALLEYS

The requirements for space heating and steam distribution are more or less independent of production output, hence less fuel is required per unit of production by continuous operation at peak production. This makes less frequent such additional heat losses as those occasioned by starting, stopping and standby of boiler plant and system, spreading such losses over a larger output.

Operate Boilers at Efficient Point Fluctuations in load cause the boilers to operate at inefficient low load part of the time. At peak of production, steam pressure drops, so that the boilers are forced to meet demand, which later falls off, and safety valves blow. Dampers are then closed, but safety valves continue to blow for some time as demand is decreasing at a more rapid rate. Conditions finally reach equilibrium, only to meet a new high rate of demand which cannot be immediately met, so that demand or production in the plant must be delayed. Blow from safety valves may be anywhere from 1 to 10% of the steam generated. Steadying the load becomes paramount, efficiency is then of secondary importance, and probably cannot be met anyway in view of the rapid fluctuations in load; proper combustion and draft suffer, coal in the ash increases, and there is carry over of water to the steam mains. Fuel cost per unit of product goes up.

Cooperation of Factory and Boiler Plant All of these peaks and valleys of the load curve may be unnecessary and if a visit to a like plant with like production discloses none, then something is wrong in the first factory and not in its boiler plant.



Where production follows a routine time schedule and there is co-operation between factory and boiler plant, it is not so difficult for the plant engineer to anticipate and meet production demands. Staggering lunch periods will be of help. Large hot water storage tanks will eliminate peak demands for hot water. Production, ventilating, and steam consuming equipment can be operated so that peaks of each load do not occur simultaneously. Some processes can be carried on just as well in the valley of the load.

Purchased Power for Peaks It may in some cases be a good plan to purchase power on peak demands. This may offer still other advantages, as when the load is more than enough to furnish exhaust steam for heating. This may occur in non-heating months, in spring or fall, or at other times. Purchased power at such times may be much more economical, because a steam engine in the plant may require about 5 lb of coal per kw hr, whereas the public utility may only take about 1 1/3 lb.

Save Fuel in Production As a general rule more fuel can be saved in the factory than in the boiler plant. In the factory it is not uncommon to find industrial furnaces emitting high temperature flue gases and wastage of steam on every side in distribution and process consumption. The utilization of the steam is in the hands of various important production heads whose first concern is, naturally, with product production. If, however, the production department is the cause of fuel inefficiency, it will also be the cause of production inefficiency through slowing up of the process. The overall cost per unit of product will be increased.

STIMULATING FUEL SAVING

Management holds many an exciting conference about the speeding up and cutting of production costs, not realizing that there are also real savings to be made in the production and utilization of steam. Steam is, to management, just so much fixed overhead. Production men's problems are no more technical or complex than those of the plant engineer. Staff or pep meetings are held, but the plant engineer is not invited, though he might be able to cut production costs by way of the boiler plant. It is an unfortunate part of our business life that as a rule management isn't interested in either the boiler room or its engineer. He has nothing to stimulate him. This problem should be studied, some incentive should be provided. A good bonus plan may be the answer.

Bonus on Fuel Reduction A bonus can be paid on the amount of fuel reduction. This is most simple and involves only the weighing of the coal. Bonus schemes may be based upon the CO_2 content of the flue gases, or the steam output per pound of coal consumed, or on the heat input and output of the boiler, or tons of coal consumed per unit of product made. Which is preferable may depend upon conditions at the plant, time and equipment available for records, uniformity and adaptability of the coal to the furnace, amount of coal consumption, and the ash content of the coal. It is difficult to obtain a good CO_2 percentage when the coal varies in quality. A good CO_2 recorder must be used and maintained properly, brickwork must be kept free of air leaks, carbon content of ashes must be kept low, and so on to insure accurate and fair results. The amount of fuel required for banking fires must be separately determined. If the bonus plan is based on unit of product and steam meters are used out in the factory, the plant engineer may receive the interest of all those involved in steam utilization.

Overseeing Fuel Saving Bulletins on fuel conservation may prove stimulating if not too elementary, too technical, dull, flippant, or if they do not suggest the impossible. They should be a mixture of the elementary with a certain amount of technical, and should be short and simple, what can be done and how. Publicity alone is not enough; someone should be designated as the fuel guardian. His assignment to this task should be backed by authority. Part of his responsibility would be to see that there is no overheating, opened or unlatched windows or skylights, to shut off and reduce heating and air conditioning when and where possible, to close valves, shut down motors and turn off lights when possible, and see that lights are cleaned and renewed as required.

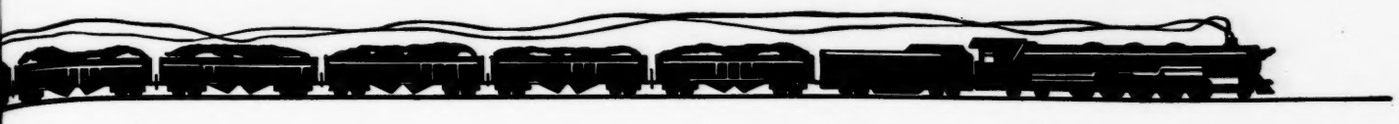
INSTRUMENTS

The ultimate measure of efficiency of a boiler plant is the cost of steam generation. Hence, it is important that records of steam generation and fuel consumed be kept so that faulty conditions can be corrected as they occur. Daily reports should be so made that they may be compared for any conditions or period of time. The size and nature of the plant will determine the investment to be made in fuel weighing devices, but in any event fuel should be weighed as it is used.

Desirability of CO_2 Recorder Ash analyses when used in connection with the amount of fuel consumed and the flue gas analyses as made by orsat samples or by flow meters for steam and air, show the efficiency of the burning equipment. A CO_2 recorder is no doubt the most valuable of instruments where the plant is of sufficient size to employ skilled operators who will give it proper attention. One meter is sufficient for two or three boilers.

Water and Steam Meters Water records as combined with fuel records help to determine economy of steam production. It is better to meter total flow of water to the boilers and the steam generated by each boiler, especially with continuous blow-down. Steam flow meters should also be used as a check on steam consumption by various departments and processes. Steam flow meters are not used in the small plant, or even in the medium size plant, to the extent they should be.

Combustion Control Thermometers are required to register the temperature of the flue gases, steam and feed water. Automatic soot blowers increase heat transfer by keeping tubes clean. Draft gages in connection with draft records indicate the draft regulation required as boiler capacity varies with the combustion rate. Dampers should be controlled from the firing room floor level so that they will be more apt to be operated as required. Large installations should have complete automatic combustion control. Excess air should be watched,



for too little means smoke, CO, unburned fuel and higher maintenance of refractories due to higher furnace temperatures. Too much excess air means higher gas velocities and less heat transfer.

Use of Degree-Day In checking steam or fuel consumption with fuel used per degree day in other plants, it is well to keep in mind certain facts, as follows: Steam consumption per degree day is not the same where radiation is inadequate or in excess, for different hours of occupancy, for all locations, for different classes of buildings, or for those with high internal heat loads. A figure selected from tests on certain buildings may be a poor goal to shoot at when applied to some other building.

Boiler plant instruments create more interest upon the part of the operator and contribute to fuel saving, increase in plant capacity, reduction of boiler and furnace maintenance, and maintain a more uniform steam pressure.

Blow Down The amount and frequency of blow-down are often determined from a chemical analysis of the water from the boiler. Where not made, the blow-down should be made at least daily, or more often, depending upon the water condition and quantity of steam generated. The disadvantages of intermittent blow-down, such as concentration variation and the blowing away of larger quantities of water while on high duty operation, have increased the use of the continuous blow-down. This consists of a small size connection with a suitable regulating valve or orifice located for blow-down without adverse effect on circulation. Only a small quantity of water is discharged at a time, though continuously, with the quantity easily varied as determined by routine chemical analyses.

OPERATING HOUSE HEATING

Each dwelling requires an amount of fuel over and above the amount consumed in the house furnace. In the writer's own home, moderately insulated, but where the heating system is designed and operated for economy, of the money expended for fuel oil, gas and electricity, the proportion of costs are about 60%, 20% and 20%, respectively. The percentages on a basis of fuel, rather than money, would be different. So would the percentages for an uninsulated house.

Adjacent Cold Rooms Partitions of heated rooms lose heat to unheated rooms at a high rate. Consequently, savings from cutting down on the number of heated rooms are most pronounced where the unheated rooms are not adjacent to the heated room or rooms and where such rooms are on the windward side and are not insulated. Felt should be placed under the doors to unheated rooms and distribution of heat to the heated rooms should be balanced throughout, as it should be when all rooms are heated.

Shields Back of Radiators A bright shield or some sort of insulating reflective surface should be placed back of exposed radiators, so as to reflect heat into the room, especially when the wall is thin, as with recessed radiators. Radiator enclosures should be fully insulated and made tight against drafts from outdoors. Radiator shields, when properly installed, deflect the warm air away from cold glass. Any radiators in the attic should be valved off in these times and attic louvers, if any, should be closed in the heating season. Insulating board is a good material for this purpose.

Use Rooms With Least Heat The next thing which can be done is to use the room which requires but little heat, the least heat if possible. Such a room would combine smallness with a southern exposure, a minimum of exposed wall and glass, and would be without drafts. If over the boiler room, fine. An electric heater can be used for short periods in the bath room and a moderate use of the gas range in the kitchen during mild weather may delay the necessity for starting the heating system until late in the fall.

Changing Habits to Save Fuel How to keep each of the costs down and in proper relativity is no problem for anyone who is willing to change a bit of his habits and routine. Warmer clothes can be worn, so that lower indoor temperatures can be carried throughout the day, especially so when the sun is out or when occupants are active. Heating can be started later in the day and season and stopped earlier by changing the night set back for longer and lower night temperature. The burner can be shut off at the switch whenever occupants leave the house, giving the added feature of protection when no one is around. Even though the house may be cold when occupants return, it is relatively warm compared to outdoors, and it does not take long to warm the air and set it in motion. Warm air in circulation is comfortable, even though the contents of the house are cold, often more comfortable than a 70F temperature with the burner off and no air in motion.

Garage Doors Heating of the house garage also takes a lot of fuel, especially so as few householders bother to close the garage doors which, even when closed, usually become, as far as heating goes, practically open after the lapse of a few years. Sagging, warping and general abuse of the doors and the action of frost on the concrete threshold make continuous wide open cracks at jambs and meeting points through which one can view the garage interior, so that a good fitting non-sticking set of garage doors becomes an exception to the rule. When garages must be heated, the temperature within should be held down to 40F, preferably by thermostatic control. Any broken glass should be replaced.

Expansion Tanks Hot water heating systems of the closed type without an expansion tank sometimes lose hot water during firing up periods, as do also those of the open tank type when too full, or when not properly vented, in which last event they are liable to siphonage.

Locating Air Vent If there is a long run of dry return main with a vent valve at the end of the main, steam will fill the main and waste heat to the cellar. This vent should be located just after the last radiator connection.

Coal in Ashes Coal in the ashes may be only 1% of the coal fired or it may be 50%. Average of probably 5% should be reduced to 2%. It is not a difficult matter to weigh the coal and ashes for a day or two to determine how much coal is being wasted to the ash pit. Coal in the ashes is caused by too much poking and cleaning of the fire and by improper regulation of combustion. It is an easier matter to regulate combustion so as to reduce the amount of ashes than it is to give but little attention to such regulation and then have to sift ashes.

Soot and Heat Transfer Soot increases the resistance to heat transfer and the heat that can't get through to the water goes up the chimney. As the temperature in the chimney increases, the draft increases up to a point where the increased draft seems to stop further soot deposits. If the soot accumulates at certain points, so as to clog a boiler flue or flues, then the draft is lessened, combustion is imperfect, and the fuel waste is much greater. In this event, the householder begins to feel the reduction in heating capacity, so that he shakes the grates and loses coal to the ash pit. This gives him more draft, due to less resistance of the fuel bed and the heat of a bigger fire. The capacity of an oil burning boiler may fall off with a soot condition, if the burner depends upon chimney draft for its operation, and the initial oil rate was adjusted for the flue gas temperature of the boiler when flues were originally clean.

Multiple Chimneys In city houses there are often more than one flue which can be used if the draft is inadequate with the one in use, and sometimes one of these will be found to have a better draft even though it is smaller, for it may be taller, smoother, straighter, or distant from down drafts. If two adjacent flues are used for a common flue, the dividing partition should be knocked out at top and bottom as far as the arm can reach. This will give a huddling chamber at the top for momentarily cushioning of down drafts and a storage space for the hot gases at the bottom to fill before the dividing wall is reached. Where this is not done, there is a strong possibility that the hot gases will go up one flue and cold air from downdrafts or natural flow will come down the other.

Soft Coal as a Substitute According to a circular of the Bureau of Mines, it is quite possible that the average home using 12 tons of anthracite per year may have to substitute 3 tons of bituminous coal this coming heating season, if hand-fired equipment is used, because a greater proportionate amount of the limited supply of anthracite must go to those having automatic equipment which can burn only anthracite.

Sufficient Air for Combustion In a survey of 50 houses selected at random it was found that 25% did not have an effective air supply for proper combustion in the furnace. Small cellars in row house type with only one or two windows were found to be the chief offenders. The air inlet opening, however, must not be larger than required, or the air will chill the cellar and floor of living quarters above. A direct air connection to the ash pit would be most desirable, unless the cellar requires some degree of ventilation.

For each 100 boiler horsepower, an opening of 2.5 sq ft is required, computed as follows: taking 18 lb (225 cu ft) of air per pound of coal or oil fuel, 12,500 Btu coal at 65% efficiency, air velocity 600 fpm, 34.5 lb of water per hour per boiler horsepower, latent heat 970 Btu:

$$\frac{100 \times 34.5 \times 225}{12{,}500 \times .65 \times 600 \times 60} = 2.5 \text{ sq ft}$$

Mixing of Coal Anthracite is 9% heavier than bituminous, hence a change to bituminous would in some cases mean less storage of coal for the same bin. However, if the bituminous coal can be fired as efficiently, especially when mixed with anthracite as usually recommended, there should be no substantial difference in the requirements for coal storage, as the two coals have different heat content. Whichever coal is used, it may be advisable to store any bin excess out in the open. In some city localities it would then be necessary to provide some kind of protecting cover over the storage to prevent mixing with thrown bottles, stones, etc.

Oil Burner Nozzles If the fuel is oil instead of coal, there is a possibility that a smaller nozzle can be used more efficiently, or that the angle of the spray needs readjustment. The burner will run longer and with a lower stack temperature if a smaller nozzle is used, but if used it must be of size sufficient for the load required and the combustion chamber must be designed for the smaller nozzle. If the nozzle is merely replaced without change in size, an improvement may still be obtained, for a worn out nozzle will admit too much oil.

Variation in Natural Draft Everyone knows that a chimney draft is quite variable, but not all realize the extent of its variations with change in outdoor temperature and in the intensity and direction of the wind. For example, a 40 ft chimney with a stack temperature of 500F and an outdoor temperature of 0F will have eight times as much draft as it will with an outdoor temperature of 50F and a stack temperature of 300F. This lower stack temperature is quite possible when heating requirements are only for a 50F outdoor temperature.

Advantages of Draft Stabilizer Because of the foregoing conditions and lack of automatic dampers, manually-controlled stack dampers usually admit too much air to the chimney, cooling the cellar and the chimney unnecessarily. They are difficult to control, for the greatest effect of any damper is obtained in its first slight movement from open position. A draft stabilizer overcomes these defects. It will hold the draft constant, so as to provide more even heat and pressure, better combustion with fewer ashes and clinkers, less firing, decreased stack losses and less excess air and hold the fire better overnight. In an oil burning boiler it will reduce the stack loss when the burner is on standby.

Operation of Stabilizer The action of a draft stabilizer, barometric draft damper, or automatic check damper, as variously known, is automatically to check the draft. It does this by admitting relatively cold air to the stack in an amount necessary as the draft of the chimney increases beyond the predetermined draft for which the damper was set, thus breaking the static pressure of the chimney and chilling the flue gases.

A draft stabilizer should have its initial adjustment with the burner on and with house and chimney thoroughly heated. If draft readings taken for the on-and-off periods of the burner show a considerable difference, it is well to check the boiler and burner size, burner adjustment, and cleanliness of the flues. The stabilizer should, within reason, compensate for the difference in draft between summer and winter, but with a cold boiler from long lay off, especially when boiler water is not maintained by an aquastat, the setting of the stabilizer should be changed with the season. If so, then the pressure of the fan and the amount of oil feed will have to be readjusted also.

Location of Stabilizers A draft stabilizer set on a tee at the rear of the boiler where the smoke pipe rises is apt to give trouble and clatter whenever the oil burner comes on. Its inlet under such circumstances is in the direction of the oncoming gas flow. The stabilizer often comes with the boiler, being fixed directly at its rear or, if not, it is usually so placed in the field. The higher the position of the stabilizer the more difficult it will be to bank a coal fire. This is due to the greater draft head from grates to stabilizer. There has, however, been some differences of opinion as to any harm which can result from its location other than at the boiler, such as near the chimney or in the chimney above or below the smoke pipe, also as to the location of the hand damper and its operation. Some tests have not proved the foregoing contention and it is probable that a difficulty in one case or with one fuel such as coal, is not a difficulty in another case with another fuel such as oil.

Experiences with air conditioning as related to

Duct Leakage and Job Revisions

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The accumulation of experiences of several companies in various parts of the country regarding duct leakage and job revisions.

ON most jobs, duct leakage does not show up until after the system has been in operation for several years, and the general efficiency of the apparatus has dropped to a point where the system immediately shows up any unusual load conditions. Duct leakage naturally becomes most severe on a job involving maintenance of extremely low temperatures or relative humidities. If the leakage is outward, this air loss represents an unnecessary expense in operation. If the duct is operating under a negative static pressure, the inward leakage may throw the entire system out of balance and make it impossible to maintain designed conditions.

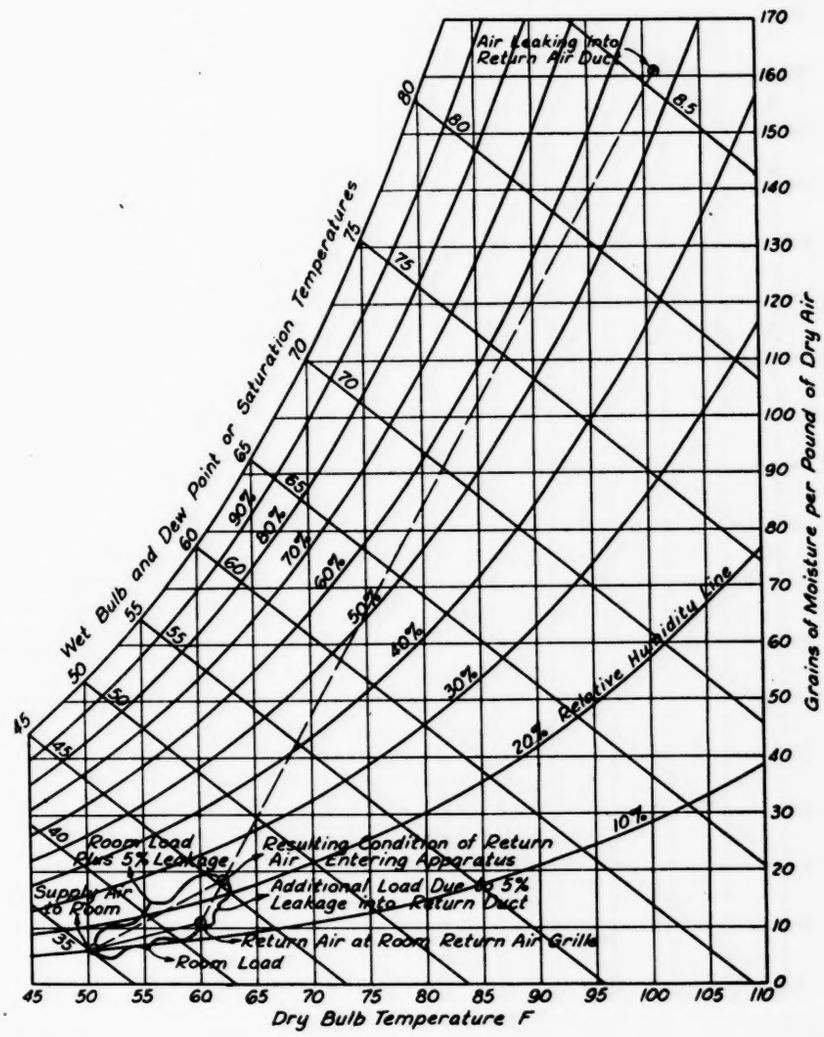
An excellent example of inward duct leakage and its effect upon the operation of air conditioning apparatus is the case of the job that was designed to operate at 60F dry bulb and 15% relative humidity. In order to lay out a "show job" it was necessary to locate the apparatus approximately 50 ft from the spaces to be conditioned. All the return and supply air ducts had to travel through a manufacturing space of extremely high humidity. In fact, it was not uncommon during the peak summer months to find dewpoint temperatures surrounding the ducts as high as 81F (161 grains of moisture per pound of dry air).

The duct work installed was of reasonable commercial tightness and some caulking had been attempted. The 50 ft return duct was under a negative static pressure and the measured inward leakage into the duct was only 5%. In addition, the positive static pressure maintained in the 50 ft run of supply duct indicated an outward leakage in this duct of approximately 8%.

In calculating the original load on the apparatus, 5% had been added to the total heat load calculations to take care of inward duct leakage. This 5% increase indicated that the return air moisture content, in returning to the apparatus, would increase the air from the room condition of 11 grams per pound of dry air to slightly less than 12 grams per pound.

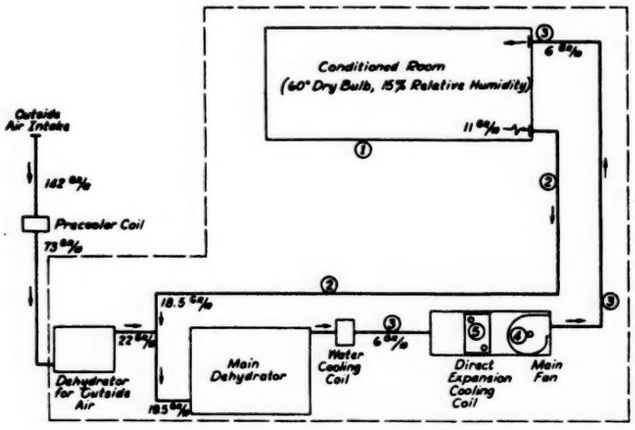
A simple calculation showed that the 5% inward leakage of 161 grams air into the return air duct raised the return air from 11 grams per pound to 18 grams per pound—over a 50% increase in latent heat load.

Any attempt to increase the quantity of return air to compensate for this leakage would have only resulted in more capacity loss. In speeding up the main fan, the return air duct would operate under


Air Leaking Into Return Air Duct
Wet Bulb and Dew Point or Saturation Temperatures
Relative Humidity Line
Grains of Moisture per Pound of Dry Air
Dry Bulb Temperature F
Room Load Plus 5% Leakage
Resulting Condition of Return Air Entering Apparatus
Supply Air to Room
Additional Load Due to 5% Leakage Into Return Duct
Return Air at Room Return Air Grille
Room Load

Effect of 5% leakage of unconditioned air into return of ductwork.

a greater negative pressure with an increase in the leakage of high humidity air into the duct. In a similar fashion, the positive pressure in the supply duct would be increased with a resulting growth in loss of conditioned air before it reached the low humidity room. Thus, the original intent of supplying a fixed quantity of outside air to maintain a positive pressure in the conditioned space would be nullified.



Schematic flow diagram indicating points of leakage causing capacity loss.

Area within dotted line indicates zone where surrounding air is at 101F dry bulb, 85.5F wet bulb and 161 gr per lb of dry air. Loss of capacity occurred at: 1—air leakage into the conditioned room due to negative pressure; 2—air leakage into the return air duct due to improperly caulked seams; 3—air leakage out of the supply air duct due to improperly caulked seams; 4—air leakage into the fan scroll at the point where the fan shaft passes through the end sheets; 5—air leakage through the direct expansion coil end sheets and around refrigeration pipe connections.

Additional search for sources of leakage also revealed that more than a few cubic feet of air were leaking in around the fan shaft opening in the fan casing. In addition, the cooling coils, also under a negative static pressure, were a leakage source around the refrigerant connections at the end of the coils.

This job was finally corrected so that it performed satisfactorily at all times:

1. A return air fan was installed at the return air grille in the conditioned space in order to place the return air duct under a positive pressure.
2. The insulation on all duct work was removed and the ducts were carefully caulked on both the inside and outside at all seams, after which the insulation was replaced.
3. The outside air quantity was increased slightly in order to assure a positive pressure in both supply and return duct work as well as in the conditioned space itself.
4. A series of labyrinths was installed around the fan shaft in order to build up sufficient resistance at this point and thus reduce the air leakage into the shaft opening.
5. An end cover plate was constructed for the end of the cooling coils and, after its installation, was completely caulked at all seams and connections around the refrigerant pipes.

The combination of a job involving the maintenance of 60F dry bulb and 15% relative humidity along with relatively long runs on both supply and return duct work is a rare combination. Nevertheless, it is not unlikely that other installations will be encountered in which one or more of the previous mentioned points of leakage can be serious enough to prevent the successful operation of the system.

The above example stresses the importance of good duct work on the low temperature or humidity jobs. In fact, it is not safe to consider the installation of so-called commercial duct work on those applications unless all seams are thoroughly caulked. Two cents additional spent in this way will easily save a dollar on end capacity.

Job Revisions

Probably one of the most serious problems that can be encountered is where the customer starts to add loads to his apparatus after installation. In almost every case the customer feels that he knows the system has plenty of capacity, so there is no reason to question adding just one small increment of load. There is one case where this "small increment of load" was greater than the load of the entire original installation. The customer feels he has every right to add on to his installation after it has become his property.

The condition might be likened to that of the installation of electric wiring in a building. The electrical contractor installs a number of branch circuits and fuses them in accordance with the electrical load requirements of the building. The electrical contractor cannot prevent the owner from adding more electrical equipment. If, however, the load additions are sufficient to cause blown fuses, the contractor will probably have to face the owner's wrath for a seemingly faulty installation. So it is the case with addition of loads to an existing air conditioning system.

If the owner of the air conditioning system consults the original contractor before he adds extra loads, the persons responsible for the original design can advise him of the possible effects on the remainder of the system. Too often the owner proceeds with his changes without advising or consulting the original contractor.

One case is that of a large air conditioning system involving considerable floor area with a normal air circulation of over 100,000 cfm. The customer complained that it was difficult to maintain conditions and also that all of the air conditioned spaces seemed to be stuffy. A full week was consumed in making a resurvey of the installation, a recalculation of all of the loads and tests on all of the apparatus. All equipment seemed to be performing satisfactorily with the exception that there was an unusually large air loss between the fan discharge and the outlets.

Not until that time did the engineer find that the customer had installed a take-off duct of rather large proportions in the heel of an elbow immediately off the fan discharge. The new duct addition was in such a location in the air shaft that the normal inspection did not reveal its presence. It was then that

the customer admitted installing this duct to supply a quantity of conditioned air to one of his storage spaces. The unfortunate location of this take-off duct in the heel of the elbow, plus its large size, was sufficient to scoop out almost 30% of the entire air circulation of the fan.

Up until this extra duct connection was discovered, no one in the customer's engineering staff had thought of its presence. They had assumed that the air quantity taken off would be too small to seriously affect the remainder of the system. This is just another example of the type of operating difficulties which cannot be foreseen when installing an air conditioning system.

Another unusual case is that of a system which had been in operation for approximately 3 years. At the end of that time the customer had taken upon himself the job of cleaning out all duct work and various parts of his apparatus, instead of employing a qualified person. After the work was completed, there was a noticeable decrease in the quantity of air circulated and the system had difficulty in maintaining proper conditions. After a thorough recheck, the difficulty was found. During the cleaning period, the various pieces of electrical apparatus had been disconnected. Unfortunately, the customer's men rewired the main fan motor so that the motor operated backwards.

Spontaneous Combustion of Coal and Its Prevention

Spontaneous combustion of coal occurs when, as the result of oxidation of certain of its unstable constituents, the coal has heated to the ignition temperature, where burning (usually smoldering), ensues. There has been, and still is, much variance of opinion regarding the mechanism of the spontaneous heating of coal. However, all authorities are agreed that it is a surface phenomenon, and that, therefore, the finer the particle size of the coal, and the larger the area of exposed surface per unit of weight, the greater are the chances of heating.

A number of chemical reactions could take place in the coal, such as: 1 — oxidation of pyrite (iron disulphide or 'Fool's Gold'); 2 — oxidation of unsaturated organic sulphur compounds other than pyrite; 3 — oxidation of unsaturated organic compounds without the formation of carbon dioxide; 4 — oxidation of organic compounds with the formation of carbon dioxide, carbon monoxide and water vapor.

Moisture is considered a factor in the oxidation process, but opinion varies as to its exact function. However, moisture is instrumental in causing the larger pieces of coal to break up into smaller pieces, with a resultant larger surface area. Moisture also causes the coal to pack, thus preventing the cooling effect of air ventilation. It, of course, requires considerable energy in the form of heat to drive off the water, so, therefore, a large amount of heat must be generated before actual burning takes place.

Although the oxidation of the pyrite alone would not furnish sufficient heat for initiating the combustion, it is helpful in raising the temperature of the coal to the point where oxygen will be absorbed much more rapidly than at lower temperatures.

The rate of heat generation usually depends upon the kind of coal and its geological age. Practically speaking, anthracite coal, of greatest age, is not subject to spontaneous heating, and can be stored safely. Of the bituminous coals, those containing higher oxygen, and especially younger coals, including subbituminous coals and lignites, heat more readily. Clean, sized, bituminous coals may be stored safely if care is taken that they are piled correctly; that is, if they are not broken up by dropping from a height onto the pile and are not piled too high.

Coal, stored during the summer months when the weather is warm, will generate more heat and fire more readily than coal stored in cooler seasons. Also, coal stored in warmer climates will self-heat more readily than that stored in colder climates. In this connection, O. P. Hood of the U. S. Bureau of Mines gives the following: "The amount of heat generated depends upon the temperature of the piece of coal. That is to say, coal put into storage at a temperature of 80F will generate very much more heat per unit of surface than if put into storage at the temperature of 60F * * * in general the rate of chemical reactions doubles for every 10 degrees rise in temperature, and if that applies in this case, beginning at a temperature 20 degrees higher means a four-fold increase in the amount of heat generated." Hence, since coal is usually stored during the summer months, special care must be taken to insure against spontaneous heating. This illustrates the importance of the ambient temperature in connection with spontaneous heating.

Up to, and within the last few years, coal has most frequently been stored in piles in the form of a pyramid, or truncated cone. This method of storage makes the segregation of the various sizes of coal.

Ventilation of coal by means of pipes or old boiler tubes, systematically inserted throughout the pile, has been often recommended and tried with varying degrees of success, but such pipes may not be effective, and they sometimes start spontaneous heating by conducting air into the fines of the pile.

The best method for piling the coal safely, and especially mine run or screenings, is to build the pile up in flat, thin layers, like layers of a cake, with fine and lump coal evenly distributed. Each layer should be rolled so that there will be no channels and flues, and so that it will be as near airtight as possible. *—From a paper on "Spontaneous Combustion and its Prevention," by Edward A. Dieterle, Journal of the Western Society of Engineers, June, 1944.*

Oil Piping—Its Design and Application

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Part 2

HAVING carefully designed the storage tank and located it in accordance with the dictates of good practice, it is only common sense to provide the connections to the storage system with equal recognition of the possible hazards involved. While the National Board of Fire Underwriters is given credit for many of the accepted methods of making such attachments, local ordinances in general require identical or similar safeguards. It would appear that most codes have in mind the protection of the "other fellow" beyond the property line, but experience has proven that safeguards for such purposes should be considered from the selfish point of view since they protect the individual on whose property the hazard is located, to an even greater extent. Let us examine the various types of tank connections somewhat in the order in which they are used.

Venting of Tanks: Every oil tank (except hydraulic or pressure tanks) should have an open vent terminating outside of buildings at least two feet, measured vertically and horizontally, from any window, door, or other building opening. The vent serves two important purposes: (1) To prevent excessive pressures within the tanks during filling, and (2) to prevent possible collapse of the tank due to too rapid withdrawal of its contents. Although the National Board requires that vents be not smaller than 1¼ inch pipe size, it is found that a safe practice, where pumps are used both for filling and delivery, is to make the vent equal in area to the filling pump discharge or delivery pump suction, whichever is larger.

Vent pipes should be pitched toward the tank so as to drain, but should not extend into the tank more than 1 inch. They should always terminate in a return bend or weather hood and have a protecting wire screen on the outlet to prevent the entrance of foreign materials.

When tanks contain fuel or other oils having a flash point less than 110F, it is recommended that the vents terminate in flame arresters. There are a number of approved types of flame arresters, some of which incorporate in their design filling and gauging fittings.

It has long been accepted that vents from several tanks should not be cross connected or "manifolded" into a larger vent. This is frequently a temptation when there is a long battery of underground tanks and circumstances make it undesirable to extend the vents above individual tanks.

Fill Pipes: The tank connection for filling should preferably be not less than 2 inch pipe for light oils and progressively increased in size for heavier oils. On large vertical storage tanks, this connection may be 6 inches or 8 inches in diameter. The fill pipe should be larger in the case of gravity filling than when pumps are employed. In the latter case, the tank openings should not be less than the size of the pump discharge. The filling line should pitch toward and enter at the top of the tank. It is accepted practice that the fill pipe should extend into the tank and be trapped or extend below the suction pipe so that the tank vapor space will not be exposed during filling.

Above ground horizontal and vertical storage tanks filled by pumping may have the connection at the bottom of the tank, in which case a check valve should be installed on the pump discharge line near the tank in addition to a gate shut-off valve.

Tank Discharge Outlet: The outlet from storage tanks is more often referred to as the suction pipe since in all large systems pumps are used to deliver the oil to the burners and the tank discharge is connected to the pump suction. On above ground storage tanks, the outlet is usually on the end of horizontal tanks near the bottom and similarly located on the side of vertical tanks. An O. S. & Y. gate valve should be located close to the tank. On underground storage tanks, "suction" connection definitely describes this outlet since the pump must create sufficient vacuum or suction to cause atmospheric pressure to force the oil up through the top of the tank and through pipe and fittings to the delivery pump.

A shut-off valve should be provided on the outlet so that both inlet and outlet lines can be closed during cleaning periods as a safety precaution for the men inside the tank. It has been general practice for many years to install a foot valve at the bottom of the suction pipe to maintain a full line when the pump stops running, particularly on light oils. The effectiveness of the foot valve is questionable in the case of the heavier oils, as it may become inactive due to sludge particles adhering to the seat. If held closed, no oil will flow; and if it should stick in the open position, it has lost its usefulness. We believe a horizontal swing check valve above the tank immediately after the elbow on the outlet is more desirable and in addition it is more readily serviced. The major portion of the line to the pump is thus maintained full and if the check is well-seated, the section of suction pipe within the tank will remain partially full.

The positive way to prevent suction trouble is to design the piping system so that excessive suction (lift plus friction loss) is not required. This phase of correct design will be further discussed later under the heading of "Theory and Calculations," where it will be seen that the solution is simple and practical.

Tank Gauges: All underground and above ground tanks should have gauges to indicate the level of the liquid when filling is done by pumping. They are not absolutely essential since the operator can check the quantity continuously by stick gauge and immediately shut off the flow at the tank. However, in large installations where unloading of several tank cars may be carried on simultaneously, additional men may often be required where one man could do the job. In some plants gauges are used to check inventories but stick gauge readings are usually used as a check or relied upon entirely. The gauge hatch for stick gauging should always be kept closed when not in use.

There are two general types of tank gauges: (1) float operated, and (2) hydrostatic. The float gauge has been used in many forms depending upon the type and size of tank in which it is installed. It consists principally of a float connected by wires, rods or linkages to either a circular or vertical dial which is calibrated to read in inches of liquid, gallons, pounds or any special units. In heavy liquids, the float may become coated with tar, grease or sludge and as a result lose its initial buoyancy to such an extent that its accuracy is seriously impaired. Likewise, where gearing is used to transmit the vertical motion to a circular dial, the "efficiency" of gearing must be taken into account in calibrating the dial or resort made to a correction factor.

To some extent these inaccuracies have been overcome in the hydrostatic gauge, whose principle of operation consists of balancing the pressure created by the head of liquid in the storage tank against the air trapped in an air chamber or conduit within the tank. A hand pump or compressed air may be used to expel the oil from the air pipe down to the "datum" or zero line in the tank. The result is that the equivalent oil pressure or head is read in terms of gallons (or other units) on the U-tube scale. There being no moving parts, this gauge requires no correction for friction loss in linkages.

In some storage tank installations where several grades of oil are handled, it sometimes becomes necessary, for various reasons, to use the same tanks for different oils from time to time. Under these conditions the hydrostatic or pneumatic gauge is at a disadvantage because it must be calibrated on the basis of the specific gravity of the liquid and if this changes the gauge must be recalibrated. However, within a relatively narrow range of specific gravities, the same gauge can be reasonably accurate by providing different scales depending upon the specific gravity of the several liquids.

Tank Manholes: Every storage tank having a capacity greater than 1,000 gallons should have a manhole. The cover should be gasketed and bolted tight at all times except when the tank is being examined or cleaned. Large vertical tanks should always have at least two manholes—one in the top, and one in the side near the bottom. When cleaning vertical tanks, the sludge can be removed through the lower manhole and the upper manhole will provide ventilation for the workmen.

Fig. 2. Typical oil unloading pump installation.

Pumps

In practically all industrial applications it is necessary to use pumps to convey the fuel oil from storage to the points of consumption. This is a decided advantage in contrast to the manual handling of solid fuels which oftentimes is necessary although mechanical handling is used in the majority of large installations.

Fuel oil pumps can be classified as:

1. Positive Displacement
   (a) Rotary
   (b) Plunger
   (c) Steam
2. Centrifugal

Use of positive displacement pumps of the rotary type is most common in industrial installations although the plunger type is used occasionally and the steam pump of the duplex type is frequently employed in connection with high pressure mechanically atomizing boiler burners. All pumps in this class must have a relief valve on the discharge end to prevent the development of excess pressure in the delivery line. Centrifugal pumps are rarely used for fuel oil distribution but are sometimes employed for tank car unloading. When so used they should be placed below the tank car outlet so that the oil can flow by gravity to the pump, thus eliminating the necessity of priming. The characteristics of the centrifugal pump prevent excessive discharge pressures from occurring, hence relief valves are not required. Since positive displacement pumps are generally used

where viscous liquids are involved, this discussion will be confined to this type.

Rotary positive displacement pumps are divided into two classes—external gear and internal gear types. There is considerable variation in the design of rotary pumps, the main difference being the shape of the gears. There seems to be no one make which is so outstanding that it is universally adopted. Each manufacturer of rotary pumps has his following and where dissatisfaction has occurred, it can be traced in many instances to improper application or incorrect design of the system in general.

Because the speed at which rotary pumps should operate is directly related to the viscosity of the liquid being pumped, it is customary to reduce the speed progressively as the viscosity is increased above 500-600 S.U.S. Likewise, good practice indicates that the speed should also be reduced with increase in pump capacity. It should be noted that internal gear pumps are usually operated at somewhat slower speeds than external gear pumps.

The liquid being pumped lubricates the gears in rotary pumps and therefore liquids such as water, kerosene, gasoline, etc., cause noisy operation because they are practically non-lubricating. Some manufacturers make pumps with external bearings for this purpose. On the other hand, fuel oil is particularly suited for handling by this type of pump. Fig. 2 illustrates a typical unloading pump installation.

Fuel Oil Heaters

The lighter grades of fuel oil do not require heating at normal temperatures to secure good atomization. Heavy oils, particularly No. 5 and No. 6 (Bunker C), have such high viscosities at room temperature that they must be heated to be effectively atomized, except in a few certain types of high pressure burners. Aside from properly "conditioning" the oil for the usual burner applications, the viscosity of the heavy oils makes it mandatory that they be heated for transmission in piping systems.

Fortunately the temperature-viscosity relationship already mentioned permits the control of viscosity by the addition of heat to the oil. Depending upon the type of oil, one or more of the following means are employed to reduce the viscosity to that desired for transmission and atomization:

(1) Heating coils in storage tanks;
(2) Suction heaters;
(3) Delivery or discharge heaters; or
(4) Auxiliary or booster heaters

Since these oils have viscosities of approximately 8,000 S.U.S. and 30,000 S.U.S. at 70F respectively, it is obvious that they must be heated in order to obtain sufficient flow to the delivery or circulating pumps. For this purpose, steam coils, hot water coils or electric heating elements may be used, although it is customary to use steam. Steam coils of sufficient size are installed inside the storage tank to raise the temperature (lower the viscosity) of the oil leaving the tank. Usually sufficient coil is provided to heat the oil at the rate of flow to the pumps as the expense of heating the entire tank is not warranted. In recirculating systems, the unused portion of the supply is returned to the storage tank, in which case, the added heat to the tank is obtained gratis since the oil had to be heated originally to obtain the desired "burner viscosity."

To obtain the desired reduction of viscosity to produce economical flow in the distributing piping and deliver the oil to the burners at suitable condition for atomization, delivery or discharge heaters are installed after the pump. These heaters impart the greater portion of heat to the oil in the most economical manner as they are designed for the specific rate of flow and temperature desired for the particular oil being heated. The shell and tube type heater is generally used for this purpose. A modification of this type consists of a series of pipe shells in which the tubes carrying the heating medium are located and are constructed with "fins" or added heating surface; consequently, fewer tubes are required. This type has received equal recognition for efficient fuel oil heating along with the standard tube and shell type heater exchangers.

In many installations, heaters of these same types have been installed directly in the storage tanks, in which case the end of the shell or enclosing pipe is left open for the oil to flow into the unit around the tubes. Heaters of this type are called suction heaters, and when used may replace both the steam coils and discharge heaters if the required increase in temperature is not excessive.

For heavy oils, the heat exchangers are usually located in the tanks or in a pump house close to the tanks. When the delivery piping to burners is several hundred feet distant, additional heaters may be required—called booster heaters. Their use is necessary when the radiation loss in the transmission line is excessive since the maximum temperatures to which oil should be preheated are fairly well defined. If fuel oils are heated above their flash points, operating and atomizing difficulties may result. The following table gives approximate preheating temperatures for fuel oils:

Gravity, A.P.I.	Temperature, F	Gravity, A.P.I.	Temperature, F
10-12	275-325	18-20	140-160
12-14	220-275	20-22	100-140
14-16	175-250	22-24	80-100
16-18	150-200	24-26	78-80

So many variables are involved, such as types of heaters and available heating media, temperature required by conditions of the delivery systems and burner design, and grade of oil being handled, that it is simpler and more practical to submit the known data of temperature rise required, rate of flow, viscosities and steam pressure to reputable heater manufacturers and obtain their recommendations than for the average engineer to design his own heat exchanger.

Industrial Burners

While this article pertains primarily to the equipment used and the design of pipe distribution systems for fuel oils, it would not be complete unless some mention were made concerning the various types of oil burners available for industrial processes. Industrial oil burners may be classified in accordance with the method of atomization; as, low pressure air, high pressure air, low pressure steam, high pressure steam and various types of mechanical atomizing burners using high pressure oil. In the industrial field, low pressure air atomization is probably used to a greater extent than any other type. Usually individual blowers supply air at 15 oz to about 2 lb for each furnace. As a result, better control is obtained as well as greater turn-down (lower capacities).

In certain instances of low pressure air and high pressure air atomization, the oil pressure at the burner is not important, but it is essential that the oil reach the burner in a proper state for atomization and that means the viscosity must not be higher than that for which the burner is designed. However, there are many applications of low pressure air atomization where the oil is delivered at about 35 lb per sq in to the burners. Since No. 5 and No. 6 fuel oils are generally used, except in special cases, preheaters are required and the control of the viscosity readily obtained. The pressure range for high pressure atomizing air is approximately 30-85 lb per sq in.

Steam atomization requires steam pressures ranging from 30-100 lb per square inch.

The mechanical types of atomization consist of two classes: (1) High pressure oil, and (2) rotary burners. In mechanical atomization, the oil, usually of the heavier grades, is delivered to the burner at pressures ranging from 75-100 lb per sq. in. to as high as 250-300 lb per sq. in., depending upon the type of burner and service required. The rotary burners are of several types, some of which can be used for lighter fuel oils as No. 1, No. 2 or No. 3, but they may often be used to burn Bunker C in oil-fired boiler installations.

Fire Protection

Use of foam for extinguishing oil fires is regarded as one of the most effective methods although steam, inert gases and water fog have also been used for this purpose. The foam consists of tiny bubbles of carbonic acid gas and may be applied by several different methods. The National Board of Fire Underwriters very carefully cover the use of foam extinguishing systems and quite definitely specify the equipment, the number, size and types of nozzles to be employed under varying conditions, the method of storing and mixing the chemicals, etc. The four general types of systems are:

(1) Self-contained apparatus consisting of certain approved types of containers with devices to operate them automatically, the foam producing materials being contained within the device. This is the usual hand extinguisher.

(2) Closed apparatus containing the chemicals necessary for producing foam but having provision for the admission of water to these materials with the necessary automatic or non-automatic apparatus to produce proper operation.

(3) Generators requiring a water supply and to which dry foam producing chemicals are added, the generators being designed to mix the chemicals and water and produce a discharge of foam solution. There are two types of these generators. One type uses a single foam producing dry chemical and the other uses two dry chemicals constituting each of the two principal ingredients, the two solutions formed in the latter type of generator being kept separate until mixed in or beyond the generator.

(4) Stored solution systems. The two foam producing liquids are stored separately and handled by pump pressure or gravity tanks to produce the necessary mixing and discharge to produce foam.

The effectiveness of the foam smothering action re-

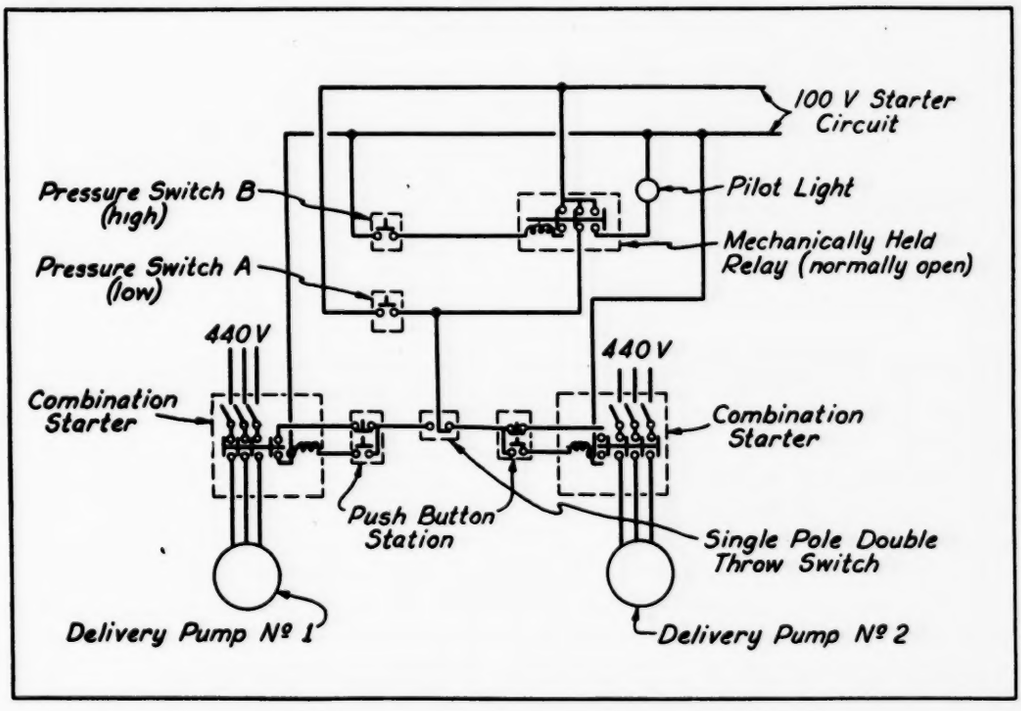


Fig. 3. Wiring diagram illustrating the connection of two pressure switches and a mechanically held relay in the starter circuit for two delivery pumps.

sults from its ability to flow over and float upon the oil. Since it also adheres to most surfaces, it protects them against fire by displacing the oxygen required to support combustion. The installation of permanent foam generators or mixing systems, distributing piping and nozzle outlets are only required on large above ground storage system. For small tanks in diked areas, elaborate foam systems are not required. However, adequate fire protection should always be provided and even for small installations, whose failure may result in a serious production loss, proper protection is desirable.

Distribution Piping

The piping between storage tanks and burners deserves as much attention as the equipment itself. It is good practice to bury piping wherever possible, and where exposed the piping should be guarded against mechanical injury. Many serious oil fires in industrial plants have resulted from broken pipes. Standard weight wrought iron or steel pipe is suitable for normal pressures up to 125 lb per square inch, above which extra heavy pipe should be used. Seamless steel tubing Schedule 40 and 80 may be used for low pressure and high pressure installations respectively. Due to war conditions, brass pipe and copper tubing have been eliminated except in very special cases. Ordinarily, soft temper copper tubing with compression fittings is used when it is necessary to avoid obstructions around burners and sometimes for buried oil piping when the pressure is less than 100 lb per square inch and when the size required does not exceed 1½ inch internal diameter. Copper tubing, aluminum tubing and flexible hose are generally used for small connections at ¼ inch to ½ inch at burners.

All fittings for low pressure steel or wrought iron piping should be standard weight cast steel, malleable iron, or welding fittings. For high pressure lines, cast steel fittings or welded joints should be used. In all cases, welded joints are preferred. On suction lines, not exposed to mechanical injury, cast iron fittings are sometimes used. A good rule to follow is to weld all joints on underground lines, and weld all joints on above ground delivery mains 1½ inch diameter and larger.

Protection of Underground Pipe

Underground piping should receive proper coatings of tar or asphalt corrosion-resistant paint. Hot oil lines are usually encased in steel or split tile conduits together with a steam line — both lines being insulated as a unit so that the effect of the steam line will offset the radiation from the oil line. This practice is followed on overhead installations as well.

Since no insulating material is 100% efficient, oil that stands in a line will eventually cool to the point where its viscosity may create excessive friction and the pump may not have sufficient power to start the oil in motion again. Furthermore, after prolonged idleness in the lines, the oil will be in no condition for proper atomization. For these reasons, it is customary to circulate the hot oil back to the storage tanks. Ordinarily, furnaces are not in a single line layout; consequently, the circulating system must be divided into branches. The amount to be delivered by the circulating pump may vary from 1½ to 3 times the average maximum furnace demand so as to insure hot oil of the necessary viscosity for the burners at all times. The total quantity of oil pumped is apportioned between the branch circulating lines on the basis of the average maximum requirements of each branch. The balance is allowed to pass through relief valves or fixed orifices at the furthest point in each branch. These return branch mains are connected into a common header returning the oil to the storage tank. The setting of the relief valves is determind by the maximum oil pressure required by the burners in each branch main.

Connections are made to the supply main or branches with extensions to the piping at each furnace. When the burners are at a considerable distance from the supply mains, the piping may be run in floor trenches with removable covers, and a return service line provided so as to minimize the amount of cold oil in the system each time the furnace is fired after a shutdown.

It hardly seems necessary to mention that all pumps, temperature regulators on heaters, burners, and so on should be protected by strainers. It has been found that the removable basket type strainer of the straight-through type will in many cases eliminate the necessity of dual strainers.

Outside screw and yoke gate valves are extensively used because the position of the valve stem indicates whether the valve is closed or open Similarly, lubricated plug cocks of the type using stick lubricant forced into oil grooves are recommended. The position of the plug indicates the open or closed position and in addition requires a wrench to operate. This fact tends to prevent operation by unauthorized persons. The friction drop is extremely low and it has the added advantages of ease of operation under pressure and the minimum possibility of leakage occurring. Globe valves are seldom used because of the high pressure loss they impart to the line.

Safety Controls

By-pass relief valves have already been mentioned as safety controls on pumps. Emergency shut-off valves should always be installed on oil lines entering a main building. There are a large number of safety-control valves designed to protect the various parts of the system including failure of furnace operation due to mechanical causes. The controls with which we are interested are only those concerned with protecting the oil handling system up to the burners and they are similar to the excess pressure and pressure failure mechanisms used on gas systems. However, since pumps are involved in the distribution of fuel

oil, we must make provision for stopping the pump in the event of a break in the delivery line. One electrical device we have used is shown in Fig. 3. When a serious break occurs in the oil delivery line, there is a drop in pressure throughout the circulating system, therefore it is possible to use a pressure switch of the mercury tube type to open the motor power circuit and stop the pump. Although this is easy to accomplish, it is more of a problem to make the safety control automatic on starting the pump as well as when pressure failure occurs.

Pressure Switch Connections

The wiring diagram (Fig. 3) illustrates the connection of two pressure switches and a mechanically held relay in the starter circuit for two delivery pumps. One pump is a spare so that only a single pump is running. The operation of this control is as follows:

(1) The pressure switches are adjusted to open with a drop in pressure and have an operating differential between them of 10 lb. Pressure switch A is the safety control; Switch B is used to disconnect the by-pass when the system is above the pump cut-out pressure.

(2) The motor is started in the usual manner by the push button control with the starter current passing through the by-pass.

(3) As the pump builds up the pressure in the line to the cut-off pressure, Switch A closes its circuit and acts as a shunt or by-pass.

(4) As the pressure in the line further increases, a point is reached when Switch B closes and energizes the coil in the relay causing it to open, thus breaking the by-pass circuit. The pump is now operating under full automatic pressure control. With a drop in oil line pressure to the critical point or setting of the safety Switch A it will open, thus disconnecting the pump circuit and stopping the pump.

The principal advantage of this control circuit is the fact that it is automatic. A single pressure switch could be used with a manual by-pass switch to permit starting of the pump motor, but the danger would lie in the fact that after the system had reached the operating pressure, the operator might forget to go back and disconnect the by-pass, in which case there would be no safety control for the installation.

(To be continued)

Ventilation Laws Not Definite Regarding Air Weight

Ventilation laws fail to state the condition under which air is measured and while the unimportant matter of volume is prescribed, the weight or oxygen content is not. This is odd, because (1) it seems like a backhanded way of going about the matter; (2) the law is very fussy about what it includes; (3) all fans are rated on standard air of a definite weight; (4) the tendency to use less outdoor air is not far from the point where further subtractions are dangerous; and (5) although chemical considerations take into account a safe oxygen and carbon dioxide concentration, the oxygen content outdoors is not a constant.

Under such conditions anyone can evade the law by measuring the volume of air just after the heater in the heating season. Ten cfm of outdoor air is not 10 cfm of air delivered to the occupied space. This law evasion may or may not be of no great practical importance, for it would be an extreme case where failure to specify the weight would amount to a difference of more than 10 or 15% in the quantity taken. Such a difference is not much greater than the experimental error possible in making a field measurement. If the work is standardized, as it should be in this day and age, it would eliminate a lot of discussion when testing jobs that fall a bit short of requirements.

In any computations dealing with heat, since it is the weight of air which has to be heated, it is most convenient to keep all computations in standard air rather then the specific volume at the particular condition. Of course, corrections must be made when selecting any fan or equipment operating at other than standard conditions. It is also most confusing, and more productive of error, to be continually changing the volume as it expands or contracts in passing through heating or cooling equipment; it is still more difficult for someone else to check the figures or know immediately what method the computer used. Some engineers keep all computations in pounds rather than have the results given cfm.

While discussing undetermined things, it may be in order to introduce the relative humidity outdoors under very cold conditions. In general, humidity is high when the temperature is as low as zero. Obviously, it is not 100%, except when snowing, and can be considerably lower with a dew point corresponding perhaps to the minimum dry bulb temperature reached during the night.

For example, if the temperature dropped as low as —20F and then rose to 0F, the humidity could be as low as 30% at the latter condition, although this is unlikely when there is ice and snow around which tends to raise the vapor pressure. Of course, it is fully appreciated in this little discussion that at very low temperatures the difference in the total heat of air is small for a wide range of assumptions as to relative humidity. At any rate it is something not determined and probably so mainly because it is difficult to measure the relative humidity at low temperatures.—*T. W. Reynolds*

WASHINGTON NEWS

Distribution of Surplus Material; Freon Still Continues Scarce; Metal Condition Improved

Summarized by LORING F. OVERMAN

Biggest news of the month in Washington, from the standpoint of those interested in design, production and use of civilian air-conditioning equipment, is not so good. It is simply this: Freon is again in tight supply—about as tight as it was in July of this year.*

While this about-face in the Freon supply situation need have no long-range negative effects on the industry, indications are that for six months or so the brakes will be applied to the A-C civilian production plans that were nearing the "final approval" stage on WPB desks.

Instead of amending Conservation Order M-28 to remove the restrictions it places on delivery of Freon for use in comfort air-conditioning systems, the order was slated for amendment late in September to extend the September 30 expiration date indefinitely. As originally written, the order withheld Freon deliveries to a specified list through August 31, 1944. With Freon supplies apparently just around the corner, WPB amended the order during August to extend the restriction another month. The new amendment to the Order will carry no expiration date—significant evidence that WPB does not expect the new shortage of Freon to be a matter of weeks.

Hydrofluoric Bottleneck

The new shortage of Freon is not due to any failure of the new East Chicago, Ind., plant to get into production, but to another shortage—that of hydrofluoric acid, needed in the production of Freon.

Of the 1,060 tons of hydrofluoric acid promised producers of Freon for October, only 685 tons will be available, the chemicals bureau of WPB advised the commercial refrigeration and air conditioning industry advisory committee, meeting September 13 in Washington. It was reported that hydrofluoric plants are producing only approximately 75% of their overall expected October quota, because manufacturers overestimated their production capacity and because two new plants failed to begin operation on schedule.

Members of the advisory committee recommended that immediate steps be taken to increase production capacity, and the WPB chemicals bureau is considering approval of new facilities that would boost output by 10%. This increase could not be expected for three or four months after such new plants, if authorized, were placed in operation. The subject is also being given attention by the program adjustment committee of WPB, for the Freon situation appears to be another of those in which secret military projects are involved.

How High is Up?

As has been so frequently demonstrated since the beginning of the war production program, facilities planning can be greatly underestimated if all military cards are not laid on the table—or if those who read the cards discount them in making their plans. There is also that natural tendency to avoid creation of surplus facilities. Result is that the military, after making its recommendations, knows that if its requests for production facilities are slashed, can come back at the proper time and take what it needs regardless of the effect on civilian economy.

While there are no indications that military recommendations were over-ridden in outlining hydrofluoric production, the fact is that military demands for the acid, as well as Freon, continue to grow beyond the highest level thought possible, judging by pre-war standards. Currently, the production of Freon stands third in line when hydrofluoric acid is parceled out, with direct military needs and the high octane gasoline production program as first and second, respectively. And of the Freon that is produced, military needs again appear first.

Endless Chain

Facing such an endless chain of demand, all adding up to continued shortages of Freon for civilian purposes, the WPB special equipment branch, quite understandably, can see little need of moving ahead of Freon in its plans for authorizing construction of civilian air-conditioning equipment.

Thus the branch contemplates no early recommendations in response to WPB Acting Chairman J. A. Krug's request for a list of plants which should be freed from military production first in order to facilitate the production of important peacetime products. It is notable, however, that first on Mr. Krug's list of industries suggested for early conversion to peacetime production was air conditioning. Other items on the list of interest in the heating and ventilating field were commercial refrigerators, oil burners, and stokers.

*EDITOR'S NOTE—R. J. Thompson, refrigeration engineer, Kinetic Chemicals, Inc., has called our attention to misstatements in the September Washington News report dealing with "Freon Control Extended." Mr. Thompson writes:

"The expected release of "Freon-12" for comfort cooling air conditioning has not been delayed as "Freon-12" probably will not be released by WPB until possibly the latter part of this year as originally intended or planned. However, the forced conversion of commercial and industrial refrigeration systems from "Freon-12" to some other refrigerant was expected to expire on August 31, but was extended by WPB to September 30. This portion of Conservation Order M-28, dated August 21 and covered by Section (b) (2), paragraph (i) to (vii), does not apply to comfort cooling air conditioning systems which are shown in List A and as specifically stated in (b) (2).

"The reason for the extension of data covering forced conversion and the possible delay in the release of "Freon-12" for comfort cooling air conditioning systems is that the allocation of hydrofluoric acid which we require in the manufacture of the "Freon" refrigerants has been considerably reduced by WPB. Therefore, our production of "Freon-12" for the month of October will be reduced approximately 40% below our production capacity.

"The time extension of the Order M-28 was due entirely to the shortage of hydrofluoric acid and was not due to delay in completion of our plant at East Chicago, Indiana. In fact, the East Chicago plant started production on August 15 as scheduled and several multiunit carloads of "Freon-12" have already been shipped. The East Chicago plant is now complete and operating at only one-half the capacity for which it was designed and will continue to operate on a reduced schedule until such time as sufficient hydrofluoric acid is allocated to us by WPB. The Carney's Point, New Jersey, plant will operate at approximately 65% capacity due to shortage of hydrofluoric acid and for the same reason.

"Hydrofluoric acid is used on the manufacture of aviation gasoline by the alkylization process and to support that program, much of the present production of hydrofluoric acid has been taken away from the "Freon" program. Just when "Freon-12" will be released for all refrigerating and comfort cooling air conditioning systems can only be answered by WPB who allocates the hydrofluoric acid which we require and who allocates each and every pound of "Freon-12" which we manufacture."

WPB air conditioning officials observe that the air-conditioning industry as a whole will not require a reconversion of production so much as it will a change of customers, since it is now producing the same type of units it normally manufactures in peacetime, but with Uncle Sam as its customer instead of the American public.

Certain divisions of larger companies, however, are producing direct military items instead of the A-C or commercial refrigeration items made before the war. The desire of these companies to be freed of direct military items to return to their pre-war fields may possibly be slowed somewhat by the unexpected return of the Freon shortage.

In response to Mr. Krug's request, however, the special equipment branch will advise that the hydrofluoric situation is the major bottleneck, and that with its correction, cutbacks of military orders could logically be applied to such marginal plants as may desire an early return to the refrigeration field. WPB A-C officials also call attention to a second possible bottleneck to early solution to the Freon problem—the shortage of cylinders. Twenty-five pound cylinders are again subject of a roundup drive, and WPB has issued a directive requiring the return of 2,000 pound cylinders in 30 days, and containers for aerosol in 15 days.

Personnel Shifts

Month-end found the WPB special equipment branch, which includes refrigeration and air-conditioning, moving again in its Tempo E building, and shuffling its top personnel. Frederick W. Smith, chief of the branch, has resigned to join the Carrier Staff, and C. M. Stuart, his deputy, takes over as head of the branch. F. B. Millham follows Mr. Stuart into the post of deputy chief, and policy matters affecting all equipment handled by the branch will center in the offices of Mr. Stuart and Mr. Millham.

Assigned to details of the A-C program is William A. Smiley, with Bert Meyer and Howard Keeler in charge of commercial refrigeration. Gordon Wooten continues to supervise CMP activities of the branch.

Surplus Setup Shaping

Now from shortages to surpluses. With shortages bedeviling WPB, but with huge surpluses certain to follow VE-Day, the Washington way is to plan an entire new setup to take command of the latter situation. Although still in the formative stage, it begins to appear that commercial heating, ventilating and air conditioning equipment surpluses will be distributed through the Defense Plant Corporation, with domestic units clearing through Treasury Department, Procurement Division.

George A. Dench, formerly with plumbing and heating division of WPB, has returned to Government after several months absence, to head up domestic plumbing and heating surplus distribution for Treasury. Neither Treasury nor Defense Plant Corporation have selected personnel for refrigeration or air-conditioning distribution.

Planning Encouraged

While early authorization of construction of equipment requiring the use of additional Freon is considered unlikely, there is no ban on the planning of return to civilian production. Too, the bars surrounding metals supplies are being taken down in various ways, with the result that some segments of the industry may not find themselves greatly handicapped in their pre-war plans.

Assignment of planning engineers and technicians to blueprint industry's return to civilian production has been approved by the War Manpower Commission in a recent directive to local offices.

"Although a relatively insignificant number of workers will be needed for reconversion planning," Mr. McNutt said, "it will shorten immeasurably the time needed to get civilian production under way. For example, it is estimated that the assignment of less than 200 technicians to planning in a single plant employing 16,000 workers may affect the employment of half a million workers immediately following the close of the European phase of the war."

Mr. McNutt listed two guiding principles for the authorization by the WMC field staff of personnel for reconversion planning, as follows: (1) the assignment of workers shall be limited to planning engineers and technicians and shall not constitute a drain upon production workers needed for continued urgent war output; and (2) no civilian production shall be undertaken which would interfere with war work of high urgency.

All resumption or expansion of civilian production, with two exceptions, Mr. McNutt reminded, require certification by the WMC. These two exceptions are (1) establishments located in critical West Coast areas employing 50 or less, and those located in other areas employing 100 or less, and whose total number of employees will not be increased; (2) certain essential production listed under WPB scheduling Order M-293, where the proposal involves an increase in production but no additional workers.

Metals Favorable

In considering plans for resumption of civilian production, it is interesting to note that metals, originally the bottleneck of military production, have reached a production level where the Japanese phase of the war can presumably be carried on after VE-Day without greatly impinging upon the metals supply needed by civilians. Aluminum is admittedly a surplus, copper is a borderline item, and equipment manufacturers are being reminded that a 40% cutback in military steel orders, expected shortly after VE-Day, would when added to that already allotted to civilian production, represent an amount actually exceeding that used for civilian purposes in a normal pre-war year. Similarly, a 40% cutback in military orders would release some 4,000,000 workers, it has been estimated. Thus, in its overall planning from topside, WPB contemplates that when the European phase of the war is over, civilian production can be given an almost unlimited go-ahead.

The announced plan of Acting Director Krug for VE-Day provides for removal of almost all controls over materials immediately, and authorization of unrated production of all types of goods. Continued would be emergency ratings for the Pacific War, and allocation orders for a few short items, such as lumber, textiles, and certain chemicals.

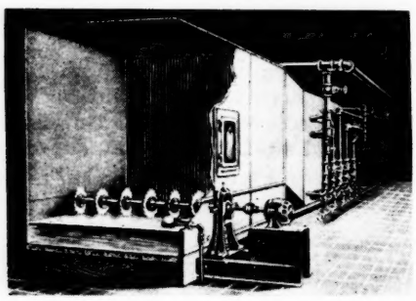
4th Quarter Allocations

Indicative of the changing picture, as it affects metals, is WPB's allocation of 100,000 tons of carbon steel and 25,000 tons of alloy steel for distribution to manufacturers of civilian goods during the fourth quarter under "spot authorization procedure." It will be remembered that the spot authorization order was the last of four sponsored by WPB Chairman Donald Nelson prior to his China mission. Designed to speed the return to civilian production, and opposed by the military, the spot authorization order permitted regional WPB offices to consider applications from manufacturers desiring to return to civilian production, and able to meet stiff requirements with regard to diverting labor and materials from war production. The spot authorization order was originally issued without making any steel allocation available to carry out production which might be authorized. Copper and aluminum allocations were made, but manufacturers were required to depend upon surplus stocks of steel.

NEWS OF EQUIPMENT AND MATERIALS

Ross Air Scrubber

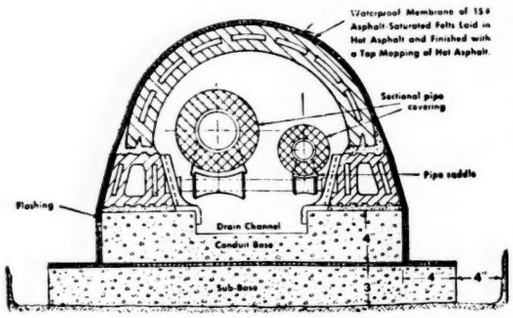
NAME—Ross air scrubber.
PURPOSE—An air washer with no spray nozzles.
FEATURES—Consists of one or more shafts on which are mounted wobble wheels direct-connected to a motor.



Rotating wobble wheels, when brought in contact with water, create a spray that fills chamber through which air passes. Spray can be regulated to heavy or light density. Special units built with dams make it possible to handle same water over and over if desired. Can be utilized to heat white water or fresh water without steam.
SIZES AND CAPACITIES—Available in 22 sizes with capacities ranging from 1000 to 100,000 cfm.
LITERATURE AVAILABLE—Bulletin 205, which includes schematic layouts of scrubber when used for water heating as well as size and capacity information.
MADE BY—*J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.*

Conduit for Wet Locations

NAME—Therm-O-Tile underground pipe conduit.
PURPOSE—Modified design for exceedingly wet or submerged locations.
FEATURES—Employs standard Therm-O-Tile design with internal drain so that in the event of condensation of moisture out of air within conduit, it can all be drained out by drain channel. Has wide sub-base beneath standard spread-footing foundation. The sub-base is wider to reduce foundation unit pressure and to simplify mechanics of joining waterproofing membranes so that leakage will be impossible. Hermetically sealed by surrounding conduit with waterproofing and then placing it on top of sub-base. Membrane usually consists of 10 lb. asphalt-saturated felts laid in hot asphalt and finished with a top mopping of hot asphalt. Weight of conduit is sufficient to prevent floating.
MADE BY—*H. W. Porter & Co., 825 Frelinghuysen Ave., Newark, N. J.*

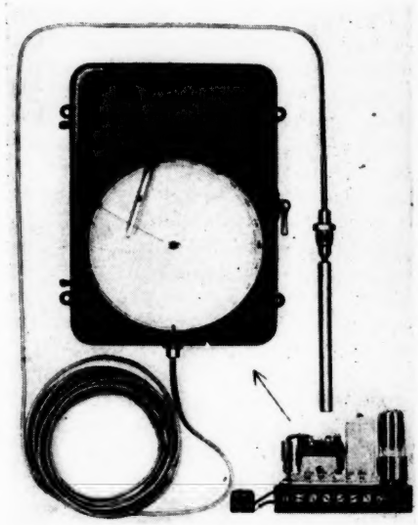


Gas Tight Zipper

NAME—Pressure Sealing Zipper.
PURPOSE—A rubber construction applied to metal slide fasteners which makes them completely waterproof and prevents escape of air or gases.
FEATURES—Construction is of overlapping rubber lips which have such initial pressures built into them that they assure a seal against any pressure which structural strength of slide will withstand. Lips are placed on either side of article to be sealed, depending on where pressure is exerted. Used on outside they make the article waterproof and prevent the escape of air, gases, or liquids held in the vessel. Uses of the development are already present in airplane industries including application on both high and low pressure ducts where sections may be effectively joined on this device, doorways and handholes, where there are pressure differentials. Can be applied to metal, fabric, or sheet rubber, providing sufficient clearance is allowed for operation of fastener. Installation can be accomplished either by stitching or cementing, depending on application.
TYPES AVAILABLE—Three styles, two being of non-separating type, first sealing along its entire length but open at top, second sealing along its entire length and at both ends. In first, slider is operated from either or both sides; in second, originally developed as a closure for pressure vessels, it is operated from side opposite sealing lips. Third construction is of the separating type, which seals for entire length but not at ends, with slider operating from either or both sides. Pressure seals are effective in a wide temperature range, not cracking when bent at —70F nor becoming soft at 150F.
MADE BY—*The B. F. Goodrich Company, Akron, Ohio.*

Electronic Controller

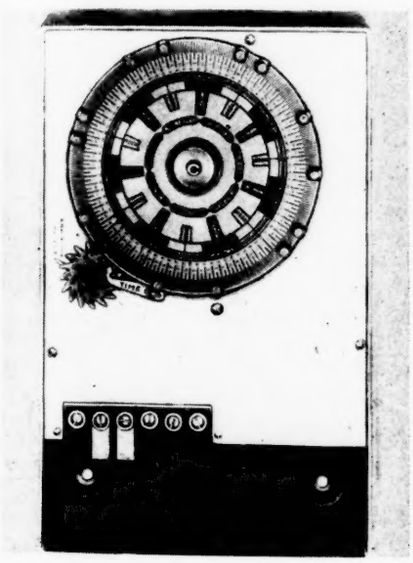
NAME—Bristol's Free-Vane electronic controller.
PURPOSE—For automatically controlling temperature, pressure, liquid level, and humidity.



FEATURES—Controller operates on shielding effect of a vane passing between two coils in an electronic circuit. Temperature controller is offered in ranges from —125F to +1000F for use in conjunction with motor and solenoid valves, relays, main line switches, and other fuel control apparatus for controlling the temperature in electric, oil, gas fired, and steamheated ovens, dryers, dehydrators, oil baths, smoke houses, tanks, and similar industrial apparatus. Pressure controller is available in ranges from full vacuum to 6000 pounds per square inch and in addition is available for automatically controlling liquid level. Humidity controller operates from a wet and dry bulb type of element with separate control for each bulb. Controller is also offered as a time-program controller for automatically controlling temperature, pressure, liquid level or humidity according to a definite time schedule.
SIZES AND CAPACITIES—Available in following types of control operation: Low-open, high-open, low-high, low-open-high, and also in low-normal-high.
LITERATURE AVAILABLE—Bull. B220.
MADE BY—*The Bristol Co., Waterbury 91, Conn.*

Paragon 7-Day Time Switch

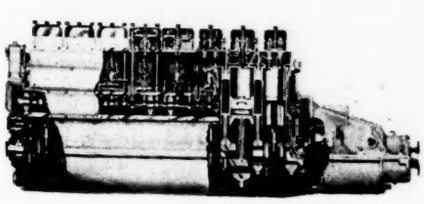
NAME—Paragon 700 series, 7-day calendar, dial time switch.
PURPOSE—For timing automatic heat, ventilating, lighting, pumping or flushing operations.



FEATURES—Equipped with 6 in. calendar dial which makes one complete revolution every 7 days. Dial trippers can be independently set for different daily on-and-off schedules. Settings can be made in advance for whole week. Any day or days operations may be omitted entirely on a pre-set program. Each day of week clearly separated from other days; graduated into hours and half hours; day and night distinctly separated. Operations from On-to-Off or from Off-to-On can be set as close as three hours apart and can be separately adjusted throughout each 24 hour day in the week.
LITERATURE AVAILABLE—Bulletin.
MADE BY—*Paragon Electric Co., 39 West Van Buren St., Chicago 5, Ill.*

Diesels for A. C.

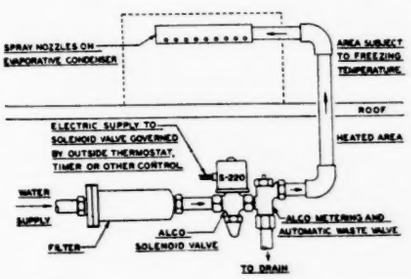
NAME—Sterling diesel engines.
PURPOSE—A new line of diesels expected to find a wide application in air conditioning, heating and refrigeration fields as well as elsewhere in industry.



FEATURES—Important feature is the fact that it provides power plant with same overall dimensions and same weight as gasoline engines of equivalent horsepower. This feature, it is stressed, is particularly notable because it means interchangeability with Sterling's Viking gasoline engine. Engine is a 4-cycle, multiple cylinder, inline, trunk piston type engine, completely enclosed. Cast cylinder block is of single piece construction, containing crankshaft main bearings at lower surface with wet cylinder sleeves inserted in upper portion of block. Bore and stroke for all models is 8 by 9 inches. Starting is effected by two 32-volt electric cranking motors situated on each side of engine. Lubrication system has two oil pumps, one to draw oil from sump beneath engine and other to supply forced feed lubrication to bearings. Speed control is effected by a hydraulic governor having wide range of speed regulations.
SIZES AND CAPACITIES—Four models, a 6-cylinder supercharged and unsupercharged, and an 8-cylinder supercharged and unsupercharged with capacities from 250 to 650 hp. Weights range from 7,500 lb to 12,500 lb for unsupercharged, 500 lb more for supercharged models.
MADE BY—*Sterling Engine Co., Buffalo, N. Y.*

Metering and Waste Valve

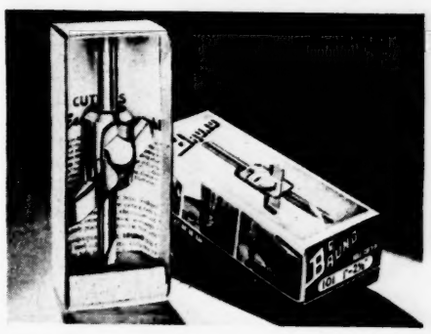
NAME—Alco metering and automatic waste valve.
PURPOSE—For water supply lines to



unheated areas, especially to spray nozzles.
FEATURES—Valve provides two services in one compact assembly: (1) automatic drain to prevent freezing, (2) means for metering. Such an arrangement for automatic draining is desirable where spray nozzles on evaporative condensers are located in unheated areas, on supply lines to roof ponds and spray nozzles, and supply lines to outside sill-cocks. Ordinarily used in conjunction with standard solenoid valve which may be controlled by outside thermostats, timers, or other means. Both solenoid and metering and automatic waste valve should be installed in a heated area. If automatic action is not desired, hand shut-off valve may replace solenoid. In this case, automatic waste feature will function when hand valve is turned off. Capacity metering stem is designed for external adjustment.
SIZES AND CAPACITIES—Pressure drop across combined metering and S220 solenoid valves of at least 20 p.s.i. is recommended for satisfactory operation. With this pressure drop valve handles 5 g.p.m.; at 50 lb drop, 8 g.p.m., and at 90 lb pressure drop, 10½ g.p.m.
LITERATURE AVAILABLE—Bull. D-771.
MADE BY—*Alco Valve Co., St. Louis, Mo.*

Bruno Hole Cutter

NAME—BRUNO.
PURPOSE—An adjustable hole cutter for sheet metals, woods, or plastics.



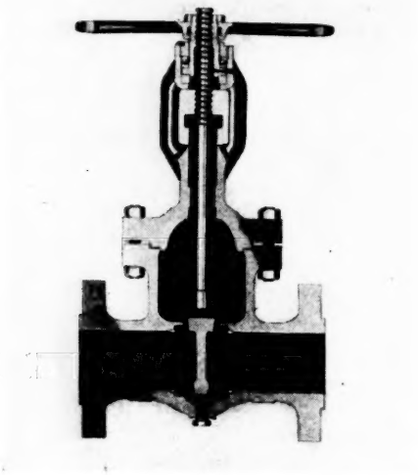
FEATURES—May be used in drill presses, electric motors or hand braces. Device consists of drill which starts hole and serves as pilot, a high-speed steel tool bit, and a shank.
SIZES AND CAPACITIES—Available in two sizes, one for holes from ⅝ to 1¼ in. in diameter through ⅛ in. thickness, the other for holes from 1 to 2½ in. and thicknesses up to ⅜ in.
MADE BY—*Bruno Tools, 9330 Santa Monica Blvd., Beverly Hills, Calif.*

Adsco Strainer

NAME — Adsco Y-type sediment strainer.
PURPOSE—For 125 lb pipe lines.
FEATURES—Has semi-steel body and removable, perforated, non-corrosive metal screen.
SIZES AND CAPACITIES—From ½ to 2 in., inclusive, with screwed ends.
LITERATURE AVAILABLE—Bulletin No. 89-4.
MADE BY—*American District Steam Co., North Tonawanda, N. Y.*

Steel Gate Valves

NAME—Cast steel gate valves.
FEATURES—To achieve perfect alignment of all working parts, close fitting wedge guide ribs are constructed



by a method which eliminates unnecessary and wear-producing drag across seating faces. Seat rings hard surfaced and welded integrally to body. Special fixtures permit hydrostatic test of both seating faces simultaneously, in contrast with customary procedure of testing one face at a time. Valves 4 in. and larger ball-bearing equipped. In smaller sizes, bearing plates for yoke bushings are Evalized, a plating process, to reduce operating effort.
SIZES AND CAPACITIES—In 300, 600, 900 and 1500 lb sp classes and in sizes 2½ to 12 in. inclusive.
LITERATURE AVILABLE—Catalog 12-E1.
MADE BY—*The Edward Valve & Mfg. Co., Inc., East Chicago, Ind.*

Water Analysis Apparatus

NAME—Aero-Titrater.
PURPOSE—For determining hardness, calcium and magnesium in waters, industrial and potable. Also widely applicable to water problems in process industries.
FEATURES—Apparatus is simple, it makes use of a new endpoint, based on foam-meter principle. This endpoint is unmistakable and is reproducible with a high degree of precision. Determinations are made within ten minutes. Operation is foolproof and gives identical results with different operators. Instrument is supplied calibrated and ready for assembly and use. All vital parts are of durable plastic construction. Samples of 50 ml. or less are required. Can be used directly with samples which contain chlorides up to 2000 ppm. Sulfates up to 1000 ppm. are also without effect. Large iron concentrations, and the treating and conditioning chemicals and compounds used in boiler waters do not interfere.
MADE BY—*Chief Chemical Corp., 1123 Broadway, New York 10, N. Y.*

Piping Slide Rule

NAME—Universal calculator.
PURPOSE—Slide rule for calculating problems involving flow of water in pipes.
FEATURES—Rule is 7 x 4 in., made of extra heavy cardboard. Instructions for use of rule are given on back. Calculator gives readings for length, size and coefficient of pipe, flow in gpm, velocity, and pressure loss. Designed by T. Francis O'Connor. Available without charge from the company.
MADE BY—*Grinnell Company, Inc., Providence, R. I.*

Photo-Layout Materials

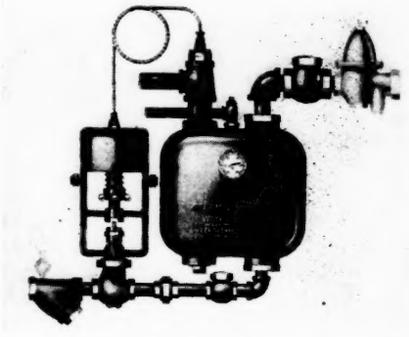
NAME—Kodak layout paint and Kodak layout paint primer.
PURPOSE—Materials for a simplified method of printing working drawings directly on metal.
FEATURES—Primer acts as a subbing base for layout paint. Method is said to be of widespread applicability for the production of products involving flat metal parts. Paint is sprayed in ordinary room light directly on virtually any primed metal surface with a conventional spray gun, after surface has been cleaned. Drying takes place rapidly and metal is ready for immediate use or can be safely stored for reasonable time in dark place. Drawing which has been previously prepared with black ink on a transparent or translucent

material is next laid in contact with prepared surface and an exposure of a few minutes duration made. Drawing is removed and the metal flooded with warm, weak ammonia water. A vigorous spray of tap water follows which washes away the exposed coating, leaving white lines where black lines appeared in the drawing. Another thin spray coat of layout paint primer protects finished product.

Method is said to have a distinct advantage over the scribing method because operators' instructions which are inked on the drawing are transferred to part to be fabricated. Reductions in scrap loss are forecast in that a layout can be prepared so as to include parts for several products. By so doing maximum use of metal can be achieved. Inexperienced operator can learn the process rapidly.
MADE BY—*Eastman Kodak Co., Rochester, N. Y.*

Steam Mixer Water Heater

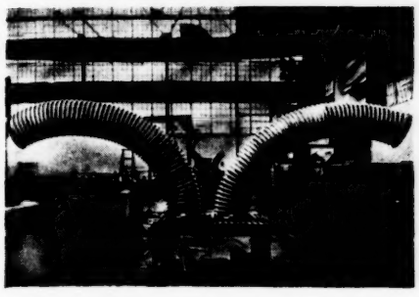
NAME—O'Brien steam mixer water heater.
PURPOSE—Complete packaged unit,



including heater, temperature regulator, temperature-pressure relief valve, thermometer and, where necessary or desired, water pressure regulator and steam and water pressure gauges, for heating water where steam is available.
FEATURES—Not only is steam delivered to water but condensate itself is utilized as hot water. Can be installed near point of use delivering water at controlled temperatures. Body of close grained iron. When conditions permit body will be cast bronze.
SIZES AND CAPACITIES—For steam pressures of 50 to 150 lb. Steam pipe sizes range from ½ to 1½ in. with capacities up to 1500 gph. A wide selection of temperature ranges available.
MADE BY—*O'Brien Steam Specialty Co., Dept. 47, 205 Harrison St., Syracuse 2, N. Y.*

Corrugated Tubing

NAME—Large diameter flexible corrugated stainless steel tubing in long bent lengths.



PURPOSE—Extensively used on diesel engine exhaust and high temperature vapor lines, connectors have applications in chemical, power and petroleum industries.
FEATURES—Connectors absorb expansion, contraction and extreme deflection in all planes. Handle corrosive liquids and gases up to 30 lb per sq in. and at temperatures from 0 to 1800F. Illustration shows two 16 in. diameter by 9 ft exhaust connectors bent at 110° for a war use.
SIZES AND CAPACITIES—6 in. diameter and over in carbon steel, any type of stainless steel, or other corrosive-resistant alloys.
MADE BY—*Zallea Brothers & Johnson, Wilmington 99, Delaware.*

Faxfilm

NAME—Faxfilm.
PURPOSE—An inexpensive method of providing a greatly enlarged picture of a surface.
FEATURES—Consists of a very small piece of plastic film softened by a solvent sufficiently to make a contact replica of any surface. Film is mounted in cardboard frame which fits any standard projector where it can be enlarged 100 diameters or more and shows all contours and three dimensions. Said to cost six cents each in small quantities, compared with several dollars for photomicrographs. Available in kits.
LITERATURE AVAILABLE—A 4-page bulletin.
MADE BY—*R. D. McDill, 5109 Mayfield Rd., Cleveland, Ohio.*

Ventube Duct

NAME—Ventube.
PURPOSE—A flexible ventilating duct designed primarily for auxiliary ventilation in ship construction, loading and unloading, cleaning or repairing ships, but also suitable for industrial uses such as building and maintenance of vats, tanks, tank cars, and boilers, or for rapidly changing air in work-rooms or drying rooms.
FEATURES—Non-collapsible Ventube is a sleeve or tube of standard Ventube impregnated cloth, either regular or fire resistant, with a tempered steel helical spring inside it. Thus the maximum airflow opening is maintained, regardless of whether duct is bent sharply or system is blowing or exhausting air. Duct weighs only half as much as an equivalent length and diameter of earlier type non-collapsible Ventube. If covering of new Ventube is burned by a welding torch or cut through, it can be patched like an automobile inner tube. Ventube is made by impregnating and coating fabrics with a high grade abrasion-resistant compound that is water resistant and impermeable to air. Fabric also is highly resistant to heat, moisture, mildew and dry rot.
MADE BY—*E. I. du Pont de Nemours and Company, Inc., Wilmington 98, Delaware.*

Heat Resisting Paint

NAME—Triple-A high heat resisting paint.
PURPOSE—For use on surfaces subjected to high temperatures, such as breechings, stacks, and furnaces.
FEATURES—Paint's resistance to heat depends on surface on which it is applied. On light steel it will harden under rapid heating and cool up to 1400F; on alloy steel, brick, and so on it will stand 2500F or over. It is non-inflammable, non-irritating and does not give off fumes or odors when being applied, or when subjected to heat or flame.
MADE BY—*Quigley Co., Inc., 527 5th Ave., New York 17, N. Y.*

Pur-O-fier

NAME—Model A-1 Pur-O-fier.
PURPOSE — To prevent free moisture, oil and foreign matter with a heavier specific gravity than air from passing through compressed air lines.
FEATURES — No maintenance is required on unit other than draining sump by opening petcock in bottom. Ball-bearing equipped for smooth operation. Parts of device subject to corrosion are plated. For intermittent operations, device is sensitive to slightest movement of air. Can be used for air-operated heating controls; air-operated gauges of the precision and checking type; air-operated cleaning devices.
SIZES AND CAPACITIES—Device weighs 1¼ lb, is 3⅛ in. diameter by 5 9/16 in. deep including plastic transparent entrainment sump. Standard units have ⅛ in. female pipe connections for intake and discharge pipes.
LITERATURE AVAILABLE—Bulletin 11.
MADE BY — *Bird-White Co., 3120 W. Lake St., Chicago, Ill.*

Soldering Stand

NAME—Model SS10 soldering stand.
PURPOSE—To give greater protection

against injurious fumes, hand fatigue and eye strain in soldering.
FEATURES—Stand enables operator to focus attention on solder joint by magnifying window. A fume stack 3 x 9¼ x 32 in. high is supplied. Has cast bracket for mounting on assembly tables or can be supplied mounted on a wood base.
MADE BY—*Dept. SS, Ess Specialty Corp., Bergenfield, N. J.*

Comfortaire Conditioner

NAME—Comfortaire conditioner.
PURPOSE—Wall type air conditioner that removes up to 90% of the latent heat with adjustable sensible heat control.
FEATURES—Maker claims unit meets demand for inexpensive dehumidifier for process industries, drafting rooms, candy stores and similar operations. Operates completely automatically, controlled by a humidistat, temperature control, and solenoid valve. Condensing unit is set to defrost automatically on each off-cycle. Since air entering and leaving unit bypasses cooling coil, dehumidification is accomplished without appreciable loss of temperature. If desired, cooler temperatures may be obtained by a slight manual adjustment.
SIZES AND CAPACITIES—Two sizes.
LITERATURE AVAILABLE—Product bulletins.
MADE BY—*American Coils Co., 25-27 Lexington St., Newark 5, N. J.*

Air-Operated Control Instruments

NAME—Model 93 series of indicating air-operated control instruments.
PURPOSE—For control of temperatures in bake ovens, drying ovens, cookers, retorts, plating tanks, and soft metal pots and the control of steam pressure, pressure in retorts or digesters.
FEATURES—Controllers are direct set instruments that can be set to control at any value within range of instrument by turning control pointer to desired value.
SIZES AND CAPACITIES—For throttling range of from ½ to 15%.
MADE BY—*The Bristol Co., Waterbury 91, Conn.*

Fosterite Plastic

NAME—Fosterite.
PURPOSE — A tough, moisture-proof plastic.
FEATURES—Especially applicable for use in such places as tropics where humidity is high and where moisture seeping into equipment may cause short-circuit or breakdown.
MADE BY — *Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Applications of Aircraft Heaters

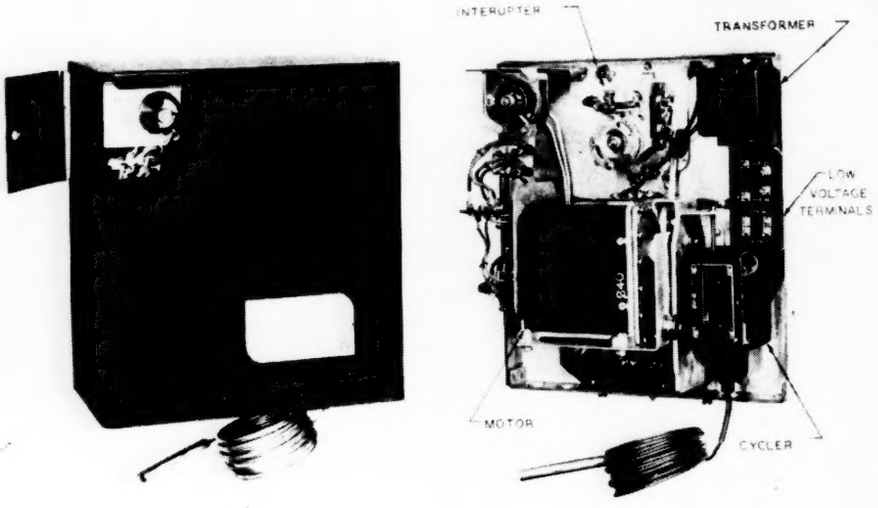
Surface Combustion, Toledo, Ohio, have reviewed the postwar possibilities of its Janitrol aircraft heater which weighs six pounds and provides 15,000 Btu per hour in one size, while another size delivers 100,000 Btu and weighs 28 lb and is two-thirds of a cubic foot in size. They burn gasoline.

The manufacturer does not contemplate applying its units to the residential field in the immediate postwar period. Aircraft heating is distinct from residential heating, the company points out. A tremendous volume of air travels over the heating surfaces of the aircraft unit at mile-a-minute velocities which wipe away the heat much faster than would happen in residential applications. The noise of this rapid air movement is not objectionable in an airplane, but is hardly the thing for a home. Temperature of the air from these heaters may be as high as 250F to 350F, as compared to 150F to 200F in the house. Again, 1,000 hours' operating life is ample for military airplane purposes. Aircraft heaters last considerably longer than that, but house owners think of heating equipment in terms of years, not hours.

However, the aircraft heater principle can be immediately adapted for some heating purposes on the ground, according to Surface Combustion. In fact, the company is making a portable unit for preheating of airplanes at arctic bases, cold-weather construction projects and thawing out trucks frozen in mud. The portable aircraft heater has many postwar uses by utility companies for heating of manholes and providing spot heating of warehouses and loading docks. However, changes to make the unit suitable for a stationary residential furnace might reduce down to producing a unit similar in design, weight and appearance to present furnaces, as successful heating appliances depend on designing them for the particular field under consideration, the manufacturer says.

Eagle Insulating Materials

NAME—Four insulating materials—Eagle Swetchek, Eagle Drycote, Eagle Hadesite, and Eagle 43 finishing cement.
FEATURES—Swetchek, an insulation for minimizing condensation, for use on cold water lines, water coolers and softeners, storage tanks, filters and condensers, is prepared plastic coating exceptionally resistant to abrasion, and black in color. Drycote, companion product to Swetchek in combating condensation, is a plastic coating, white in color, and packaged in dry form. When mixed with water and applied by trowel or hand application, becomes smooth and glossy white in color and sets into a hard fireproof surface. Hadesite is a fireproofing insulating cement for high temperature work up to 1900F. Mixed with water Hadesite is troweled to a smooth hard finish of salmon color and is used primarily for fireproofing structural steel, lining high temperature ducts, and firedoors. 43 finishing cement is used for finishing interior insulation work where an extremely hard, smooth surface is desired. It can also be painted and withstands temperatures to 800F.
MADE BY—*The Eagle-Picher Sales Co., Cincinnati, Ohio.*



Moduflow Controls

Although publicly announced almost a year ago, these are the first released photographs of Minneapolis-Honeywell Regulator Company's Moduflow control equipment. A basic component of one of the Moduflow systems, the reset Method-Moduflow panel (left) is a universal panel in that it contains all the necessary parts, including the wiring connection terminals for both the high and low voltages that are required. In addition, the reset panel permits either 24-hour operation of the heating plant at a constant thermostat temperature or lowered night temperature. The view at the right shows the panel open.

Welding Ground Clamp

NAME—Ground clamp.
PURPOSE—For welders.
FEATURES—A low-priced unit so designed that each jaw connects independently to ground cable. Thus, if one jaw is prevented from making a good electrical contact, due to any reason such as heavy scale or paint, other jaw will carry current. Has heavy-duty processed steel frame with durable copper conductors and contacts.
SIZES AND CAPACITIES—Weighs 1½ lb., maximum jaw spread of 2½ in., rating of 300 amperes.
MADE BY—*The Lincoln Electric Co., Cleveland, Ohio.*

DATA ON OVERFIRE JETS FOR FUEL SAVING AND SMOKE REDUCTION

The data on this sheet are abstracted from Technical Report VII of Bituminous Coal Research, Inc., by Richard B. Engdahl, research engineer, Battelle Memorial Institute, Columbus, Ohio, where a research program on this subject was conducted, sponsored by BCR.

Overfire jets for turbulence and prevention of smoke are applicable to hand- or stoker-fired jobs. Air can be introduced by high-pressure steam jets or by moderate- or high-pressure fans. Fan jets are decidedly cheaper to operate, but steam jets are justified: (1) where fans are not available, (2) where initial cost of fans would be prohibitive, and (3) where turbulence only is needed and additional air is undesirable.

Note that overfire jets can correct for many deficiencies, but are not a cure-all for smoke caused by extremely poor firing practice or equipment. If smoke abatement only is desired, jets should be installed only after other available means have been tried without success, such as by alternate- or ridge-firing in hand-fired plants, or by air and coal feed adjustments with stoker firing.

Fig. 1 shows important features of construction of a steam air jet. The device can be constructed of material available in any shop. Air tube can be made of standard pipe. Smooth, rounded or funnel-shaped approach to air tube can be formed of plastic refractory; or, a pipe coupling reducing from at least two sizes larger than the air tube down to air-tube size can be used. To select proper size jet first divide typical hourly coal consumption and divide by grate area in square feet. Second, amount of overfire air, as a percentage of theoretical air required, should be assumed. Where there is little smoke, this should be 5 or 10%; moderate to heavy smoke will require 10 to 30%; only for severe smoking is over 30% needed. Third, choose length of penetration. For a uniformly smoky fuel bed this will equal the grate length. If length of the region requiring air is only a part of the total grate dimension, the length of penetration will then be the length of only that part. With these three figures, refer to Fig. 2 and find D (Fig. 1).

Example: In 2-hr period under typical heavy load, 4000 lb of coal is used in 8 x 10 ft grate in boiler under 100 lb gage pressure. Moderate smoke results over whole grate length. What is inside diameter of air tube D?

Solution: Coal used per hour is 4000/2 = 2000. Dividing by (8 x 10) gives 25 lb per hr as burning rate. For moderate smoke, overfire air selected at 20%. Full length penetration is indicated —10 ft. From Fig. 2, D is 1.25 in.

Fourth, refer to Table 1 for jet spacing. For foregoing example, this is approximately 13 in. Fifth, determine air required in pounds from Fig. 4. For example given, this is 560 lb per hr per jet. Sixth, find steam nozzle diameter from Fig. 3; this is found to be ⅛ in. Last, determine the steam consumption from Fig. 5—in foregoing example 66 lb per hr per jet.

For the furnace width of 8 ft the recommended spacing results in about 6 jets spaced about one jet space, 13 in. apart and from the adjacent wall. Thus, the total steam consumption will be 436 lb per hr. This size of furnace would be suitable for a boiler of approximately 400 to 500 hp.

If jets so sized are found to give too little air, additional air may be introduced by use of larger air tubes, or more jets, without affecting penetration. Enlarging the steam nozzle will also increase the amount of air delivered, but this will require more steam and will give deeper penetration.

If it is found that the air should be decreased, but penetration must stay the same, this can be effected by means of a sleeve inserted into the full length of the air tube to reduce its diameter.

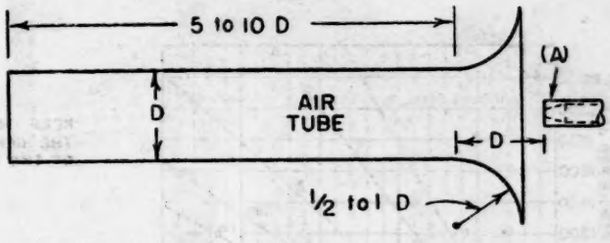


Fig. 1. Essential proportions of ideal steam-air jet. (A) Steam nozzle must be centered to within 1/32 in. of axis of air tube.

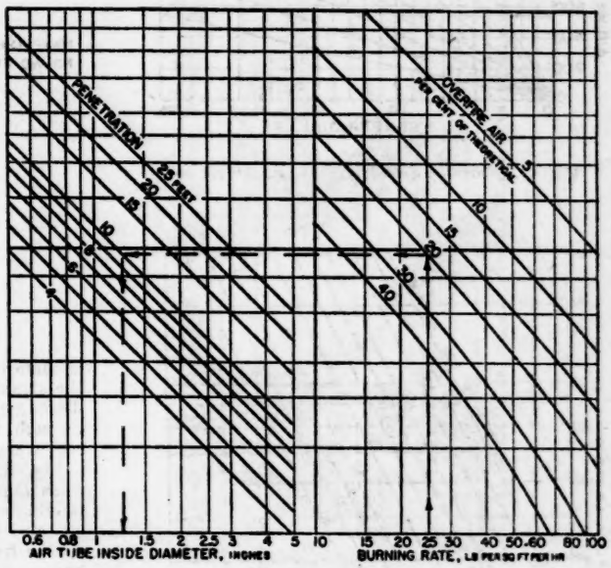


Fig. 2. Chart for sizing of air tube.

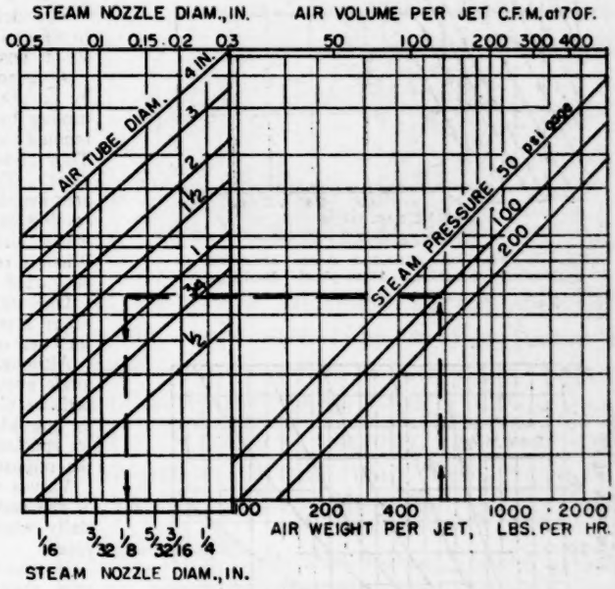

STEAM NOZZLE DIAM., IN.
AIR VOLUME PER JET C.F.M. at 70F.
AIR TUBE DIAM.
STEAM PRESSURE, 50 PSI GAGE
AIR WEIGHT PER JET, LBS. PER HR.
STEAM NOZZLE DIAM., IN.

Fig. 3. Steam nozzle selection chart.

When turbulence only is desired, the steam nozzles may discharge directly into the firebox instead of into the throat of an air tube. They will give nearly as much penetration without the air tube as with it. Unfortunately, it is not practicable to install jets with air tubes and then stop off the air inlet if it is found later that air is unnecessary. When this is done a vacuum is formed in the air tube and penetration

TABLE 1.—RECOMMENDED CENTERLINE SPACING OF JETS

(To Nearest Inch)

Penetration Length, Feet	Jet Diameter, In.					
	0.5	1	1.5	2	3	4
4	5	5	6	7	8	9
6	7	7	8	9	10	11
8	10	10	11	12	13	14
10	12	12	13	14	15	16
12	15	15	16	17	18	19
14	17	17	18	19	20	21
16	19	19	20	21	22	23
18	22	22	23	24	25	26
20	24	24	25	26	27	28
25	30	30	31	32	33	34

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DATA ON OVERFIRE JETS FOR FUEL SAVING AND SMOKE REDUCTION

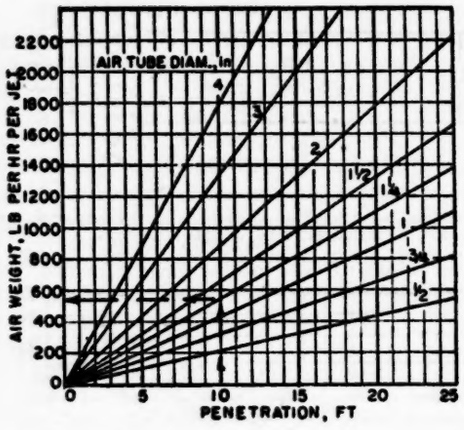

Fig. 4. Chart for determining air weight per jet.

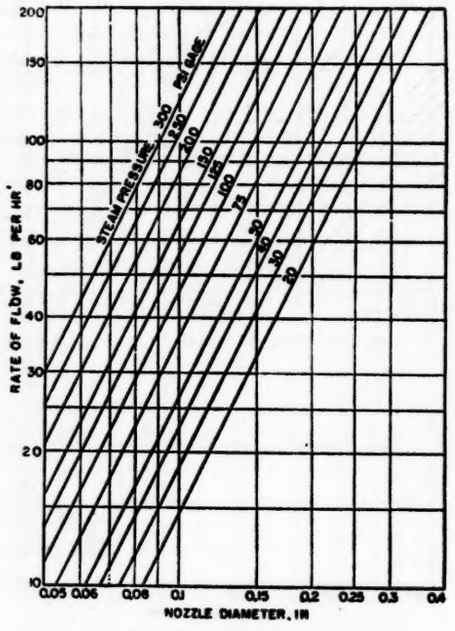

Fig. 5. Flow of saturated steam according to Grashof's equation. Atmospheric discharge.

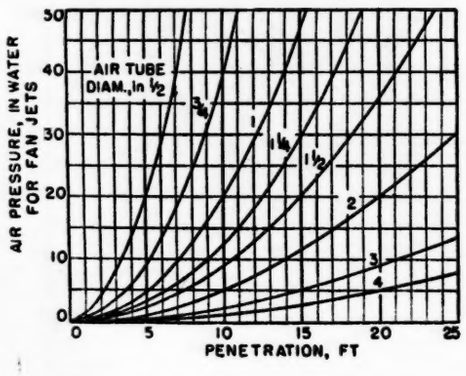

Fig. 6. Chart giving air pressure for fan jets.

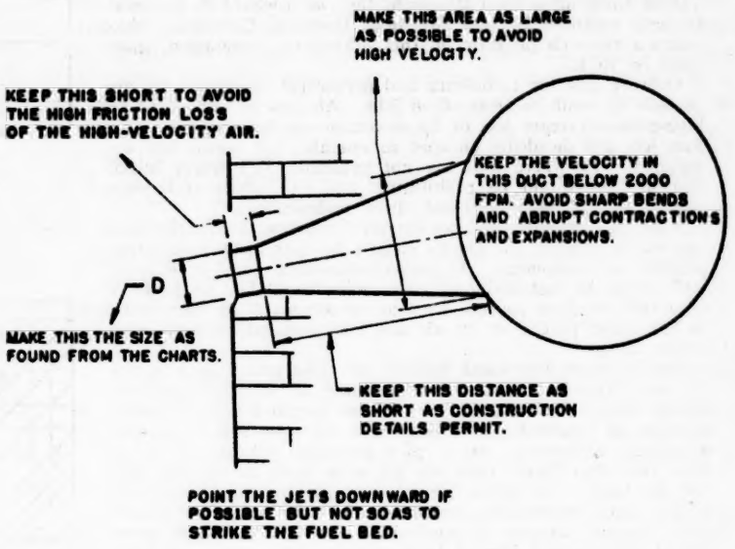
MAKE THIS AREA AS LARGE AS POSSIBLE TO AVOID HIGH VELOCITY.
KEEP THIS SHORT TO AVOID THE HIGH FRICTION LOSS OF THE HIGH-VELOCITY AIR.
KEEP THE VELOCITY IN THIS DUCT BELOW 2000 FPM. AVOID SHARP BENDS AND ABRUPT CONTRACTIONS AND EXPANSIONS.
D
MAKE THIS THE SIZE AS FOUND FROM THE CHARTS.
KEEP THIS DISTANCE AS SHORT AS CONSTRUCTION DETAILS PERMIT.
POINT THE JETS DOWNWARD IF POSSIBLE BUT NOT SO AS TO STRIKE THE FUEL BED.

Fig. 7. Cross section of a fan jet showing essential construction details.

is almost nil. When air is found detrimental but turbulence is still required, the steam line should be so extended through the air tube that the nozzle will discharge near the air tube outlet. The small amount of air which will then flow through the air tube by natural draft will serve to keep the steam nozzle cool when not in use.

Fig. 6 gives the required air pressure for the specified air-tube diameter when fans are to be used. For the conditions of the example, the jet pressure should be 15 in. of water. If the ducts leading from the fan to jets have low resistance, the required fan pressure may also be taken as 15 in. For this to be true, the duct velocity must not exceed 2000 fpm, and there should be no sharp bends or abrupt changes in area.

Fig. 7 illustrates the essential details of fan jets. In the example, with 6 jets delivering 560 lb per hr each, the fan must supply a total of 3360 lb per hr or 746 cfm at 70F against a pressure of 15 in.

Few definite rules can be made for locating the jets. A revealing technique often used is to explore the firebox with a bare steam nozzle attached to a steam hose from as many openings in the firebox as are available.

In general, for uniform fuel beds the furnace can be covered adequately by parallel jets located in the front wall. Jets in the bridgewall give better mixing by injecting air counter to the normal flow of gases, but jet maintenance may be higher because of the high temperature at the bridgewall. They should not penetrate to the firing doors because of danger to the operators. The firebox is better covered and mixing is improved when the jets are installed in opposite walls and staggered. Where smoke is observed coming from a restricted area the burning rate for that area may be estimated and jets selected from Fig. 2 and Table 1 to cover just that region. When a restricted region only is to be reached, the spacing and location may be varied at will to get intermixing of the jets in that region.

One important rule should be observed: The high-velocity stream should never scrub adjacent walls, as serious refractory erosion will result. Those jets nearest the walls should be at least one-half jet space away from them.

Although for maximum mixing the jets should be pointed downward, the angle should not be so great as to cause impingement of the jet on the fuel bed, as clinkering may result. However, they should inject the air as close as possible to the fuel bed. A safe rule to observe is: Locate the jets one jet spacing above the normal level of fuel bed and aim them at a point on the opposite wall at least 6 in. above the fuel-bed level.

Valves and pressure gages should always be installed to permit regulation of the steam pressure at the jets. To remove moisture from the lines, especially when starting, traps or hand-controlled purging valves should be provided.

If operated unnecessarily, the jets, obviously, are wasteful. If steam operated, they waste a fraction of the boiler output, and with either type they will increase the heat lost in the gases leaving the boiler if they increase the excess air. The most satisfactory insurance against such waste is the care of an alert and interested fireman. His work can be made easier by a photoelectric cell which receives light through the stack gases and actuates the jets: by alarms, such as bells or lights, whenever the smoke in the gases clouds the light to the cell more than a set minimum; or by a periscope device which enables the fireman to observe any smoke produced without leaving the firing floor.

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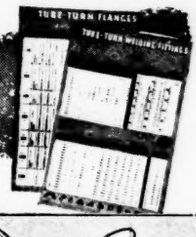
SAFE

High pressures, high velocities, high temperatures . . . stresses and strains, corrosion and erosion . . . *all* factors which tend to undermine safety in piping are resisted by *Tube-Turn seamless welding fittings.*

Laboratory and field tests conducted regularly demonstrate how Tube Turns' *exclusive* forging processes increase serviceable life by improving grain structure in the metal itself, and thus reduce wear at the most vulnerable points of a piping system — where flow direction changes! Write for Catalog 111 — it contains data valuable to all who buy, specify and install piping and welding fittings.

VALUABLE WALL CHARTS



Dimensional data on Tube-Turn fittings and flanges are shown on these two handy wall charts, sizes 24 x 36 inches—sent free on request.

Selected Tube Turns Distributors in every principal city are ready to serve you from complete stocks.

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TRADE MARK
Welding Fittings and Flanges

NEWS OF THE MONTH

Indoor Climate Institute Holds Open Forum

DETROIT—Under a banner emblazoned with the slogan "Controlled Indoor Climate is the Fourth Dimension of Living", the Indoor Climate Institute held an open forum here in the Book-Cadillac Hotel September 21-22, with over three hundred present.

The objective of the Institute was defined at the meeting as the education of consumers and salesmen in the health, comfort and convenience and other advantages of automatic heating and air conditioning. The purpose of the forum was to acquaint the industry and the press with the functions of the Institute and to attract wider support from all branches of the industry to it.

Since its inception over a year ago the Institute has made great headway in more accurately defining its objectives and method of functioning and this has been accomplished to a great extent by delimiting some of the original scope. According to C. T. Burg, chairman of the industry promotion committee of the Institute, the organization will not attempt to certify installations, establish codes or standards, will not replace any existing professional or trade associations, or engage in any other activities beyond promoting the industry as a whole; consequently, it will not discriminate among the various competing fuels nor among warm air, steam or hot water systems. Manufacturers, distributors, dealers, contractors and others connected in any way with the sale of automatic heating and air conditioning equipment are eligible for membership.

According to Paul B. Zimmerman, president of the Institute, in his opening address, the radio, automobile, washing machine and similar devices have all gone through a three-phase history each of approximately fifteen years duration. The first, or development phase, lasts until the device has reached a market saturation of approximately 10%. A steeply rising sales curve is found during the second phase when the device is sold in large numbers by specialty salesmen and which lasts about 15 years until the market is about 50% saturated. After this the acceptance period is attained where the sales curve is relatively flat but at a rather high level and with specialty selling no longer necessary. According to Mr. Zimmerman the automatic heating and air conditioning sales are at the beginning of the second phase, which requires considerable specialty selling and sales promotion. The Institute will attempt to supply this need for sales promotion.

A. E. Schanuel, newly-appointed executive secretary of the Institute, spoke on organizing the industry's sales story. He was followed by J. K. Knighton, sales manager, air conditioning division, Servel, Inc., who spoke on a new approach to an old sales problem.

Raymond M. Foley, Michigan State Director, Federal Housing Administration, speaking on the major problem in home equipment, spoke frankly to those attending and told them that the heating industry's greatest enemies were within the industry itself, referring to those who oversold low priced equipment in that the buyer was led to believe he was getting more than was actually the case. Mr. Foley was followed by Mrs. Henny Mollgaard, building contractor, who spoke on the woman's viewpoint in home building and who spoke as co-chairman of the post-war planning committee of the National Association of Home Builders.

In the first afternoon session an impressive presentation of market data on automatic heating and air conditioning possibilities was made by Ralph C. Cameron, director of merchandising, Airtemp Division, Chrysler Corporation. M. E. Skinner, vice-president, Buffalo, Niagara & Eastern Corp. described the present status of the electric utilities' proposed program for selling the all-electric home to the consumer. A practical public relations program for the Institute was outlined by Edward R. Grace, president of Grace & Bement, Inc. Plain and unmistakable answers to questions which have been asked about the Institute were then given by C. T. Burg, general sales manager, Iron Fireman Mfg. Co., who then made a plea for membership to those not already affiliated with the organization.

The following morning, group meetings were held simultaneously as follows: Editors' panel, public information committee, C. D. Lyford, chairman: science committee, Willis H. Carrier, chairman; local chapters' committee, Jack Searls, chairman; speakers' bureau committee, John Knighton, chairman; trade associations' committee, J. M. McClintock, chairman: industry promotion committee, C. T. Burg, chairman: postwar personnel and training committee, J. R. Scott, chairman; membership committee, T. A. Crawford, chairman.

Aptitude Tests for Gas Heat Salesmen

NEW YORK—Public utilities are cooperating in a series of psychological experiments designed to provide an accurate basis for selection of postwar salesmen. Data collected in 15 cities through the summer by staff members of the Personnel Research Institute of Western Reserve University of Cleveland will be used in preparing a series of tests to predetermine whether job candidates can sell gas heating equipment for home use. Dr. Jay L. Otis, director of the Institute, is in charge of the project. The research is being underwritten by Bryant Heater Company, Cleveland, one of the Dresser Industries.

When the results of hundreds of interviews with men of known sales records, containing nearly one hundred thousand answers to questions and problems, have been collated; a standard test for gas heating salesmen will be prepared and put at the disposal of the utilities as well as Bryant distributors.

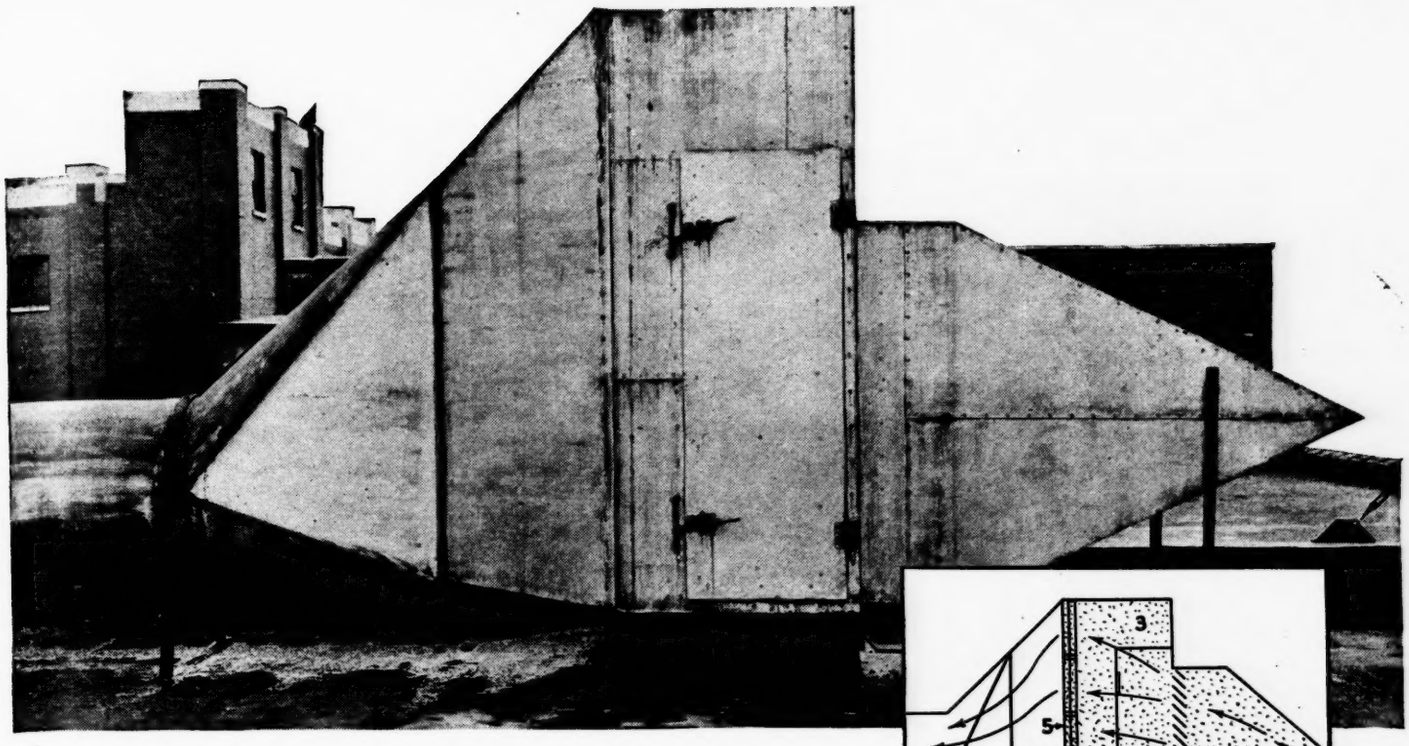
Appeal on Agent's Tax Granted

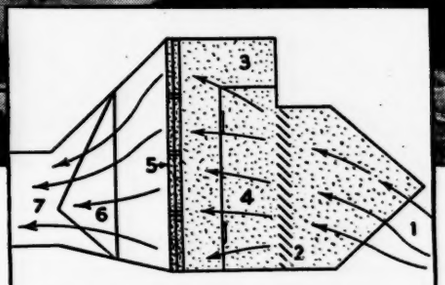
RICHMOND, VA.—Henry L. Pelouze, of the Pelouze Sales Co., was granted a Writ of Error by the Virginia Supreme Court of Appeals August 23 from a decision of the Law and Equity Court which awarded the City of Richmond money alleged to be due the City as taxes on commissions on sales of equipment sold by Mr. Pelouze for out-of-state heating appliance companies.

Mr. Pelouze contended that the City's action was in variation with the commerce clause of the Constitution in interfering with interstate commerce. Argument by counsel will be heard sometime during the fall term of the court.

The granting of the Writ of Error may indicate a trend by state supreme courts to follow the decision of the United States Supreme Court of May 15, 1944 in the case of McLeod v. J. E. Dilworth Co., 64 S. Ct. 1023, Arkansas.

While the money involved as a tax is not extraordinarily large, nevertheless the principle is regarded as of wide significance, particularly among manufacturers' representatives selling goods on commission for out-of-state companies.





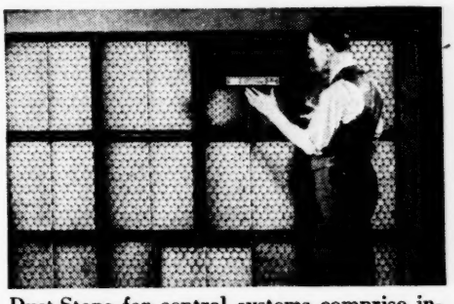
1. Roof-top air intake . . . 2. Louvres . . . 3. Plenum chamber . . . 4. Door for easy access to Filters . . . 5. Bank of Dust-Stop Filters . . . 6. Clean, filtered air . . . 7. To cooling room.

Roof-top AIR WARDEN CATCHES TROUBLESOME FOREIGN ELEMENTS

• Cinders and soot from the adjacent six-track railroad yard are kept out. Dirt from the city's streets and smokestacks can't sneak in. For this effective, economical guard permits only clean air to enter the Duquesne Brewing Company's cooling room.

This unique air intake and Dust-Stop* Filter application was designed by the company's engineering department for its Pittsburgh brewery. It indicates the ready adaptability of this replaceable-type unit to heating, ventilating and air conditioning systems of any size.

The Dust-Stop Air Filter is made of packs of glass fibers coated with an adhesive, faced with metal grilles and bound on the edges with a fiberboard frame. High efficiency is credited to the Fiberglas* filter medium and nonodorous, nonevaporating adhesive which has extraordinary wetting power. Each particle of dust acts as a wick to carry adhesive to other particles. Thus, the Dust-Stop maintains its efficiency until it becomes heavily coated with dust—then it can be easily, quickly and inexpensively replaced.



Dust-Stops for central systems comprise individual parts for each cell; steel frames, bolts, nuts, gaskets and filters—complete and ready for assembly.

The installation illustrated above, is but one example of the way engineers are adapting the Dust-Stop Air Filter to a dust control problem. Dust-Stops are also used in many industries and applied direct to many types of machinery and equipment. And, because Dust-Stops are distributed to nearly every community, replacements are readily available to users.

For complete information about Dust-Stops and their many uses write: *Owens-Corning Fiberglas Corp., 1912 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ont.*

ARMY E NAVY

DUSTOP* AIR FILTERS

—a FIBERGLAS product

*T. M. REG. U. S. PAT. OFF.

Oil Burner Increase Forecast

NEW YORK—Predictions of a sharp postwar increase in oil burner installations and of improvement in the immediate fuel oil supply situation were voiced by speakers at a convention here Sept. 20-21 of the Empire State Petroleum Association.

Albert J. McIntosh, economist for the Socony-Vacuum Oil Co., predicted that by 1949 there probably would be 3,500,000 homes having distillate oil burners, as compared with 2,243,000 in 1941.

"In New York State by 1949, if my forecasts are realized," he said, "home heating distillate fuel oils should surpass passenger-car gasoline and amount to 33,400,000 barrels a year, as compared to 31,400,000 barrels of gasoline for passenger cars."

The fuel oil supply situation for the approaching cold season was viewed optimistically by J. D. Collins, district director of the Petroleum Administration for War, who declared, however, that while quantity probably would be no problem, it might not be possible to maintain the quality of the lighter fuel oil used for heating homes.

Mr. Collins reported that residual oil inventories were 2½% above those of last year. This upswing in supply, he said, took place largely in recent months, with the winter outlook for residual oil "good," despite a 13% increase in demand.

Although reporting a 50% increase in inventories of the lighter fuel oils, or distillates, to meet a demand that has increased only 6%, Mr. Collins warned that military needs might make it essential to handle an increased amount of downgraded oil.

He further said that kerosene inventories have increased 50%, with the increase in demand for this fuel only 30% higher.

"Personally," he said, "I feel optimistic about the situation for this winter. I believe that we will get by better than we did last winter provided we all continue to exert the same kind of effort that we have been exerting for the last two years."

AWS to Hear Papers on Pipe Welding

NEW YORK—A session devoted to the welding of piping and pressure vessels will be part of the annual meeting of the American Welding Society to be held in Cleveland, October 16-19, with headquarters at the Hotel Cleveland.

The piping and pressure vessels session will be held at 2 p.m. Wednesday afternoon, October 18, under the chairmanship of A. C. Weigel, Combustion Engineering Co. Four papers will be presented as follows: Pressure Vessel Welding, by Edward B. McGuire, Hamler Boiler & Tank Co.; Normalizing of Welds in Carbon-Molybdenum Steel Pipe by 60-Cyle Induction Heating, by I. A. Rohrig and D. H. Corey, The Detroit Edison Co.; Properties of Welded Joints Between Dissimilar Metals, by E. C. Chapman and R. E. Lorentz, Combustion Engineering Co.; Oxy-Acetylene Pressure Welding, by A. R. Lytle, Union Carbide & Carbon Research Laboratories.

Plans Natural Gas Survey

WASHINGTON — The Federal Power Commission announced September 28 an investigation into the country's reserves of natural gas, to determine their probable life and future utilization and the nature of competition between natural gas and other fuels.

The commission stated that representatives of coal, railroad, labor and other interests concerned with the production or transportation of competing fuels have urged limitations for the uses for which natural gas might be sold.

Welding Papers in Ohio State Library

COLUMBUS, OHIO—All papers submitted in the James F. Lincoln Arc Welding Foundation's $200,000 award program of 1937-38, and the engineering undergraduate award and scholarship program of 1942-43, have been placed with Ohio State University's A. F. Davis Welding Library, J. R. Stitt, associate professor of welding engineering, has announced.

Hess Talks on A. C. for Flowers

LOS ANGELES—The growth of plants under controlled atmospheric conditions, cited as one of the newest and most interesting studies in the realm of air conditioning for specific purposes was outlined in a talk before the September 13 meeting at Los Angeles of the Southern California chapter of the ASHVE by Arthur Hess, heating engineer, English & Lauer, Inc.

Development in the study of plant growth, Mr. Hess declared, owes its present significance to the perfection of air conditioning equipment, without which the necessary laboratory conditions would be difficult to achieve and maintain. The speaker asserted that under artificial atmospheres, plants sometimes react strangely. By carefully controlling the artificial climate by means of an air-conditioning greenhouse, he asserted, it has been possible accurately to study results from a given set of conditions.

Numerous experiments, he said, have produced some startling results. Spray orchids, for instance, Mr. Hess pointed out, have been forced to increase the number of blooms per spray from six or seven to 60 or 70. Under certain conditions, he explained further, irregularities may be produced in the blooming dates of plants. Experiments with seeds have developed methods of speeding up the time of germination lag. Another use for controlled atmosphere, Mr. Hess declared, is that of acclimating plants from foreign regions to location conditions.

Mr. Hess admitted that the field of air conditioning from a financially profitable standpoint in this connection is still in doubt. Under certain conditions, he said, the method has proven to be a sound investment for commercial flower and plant growers. What the future has in store for this branch of air conditioning, the speaker asserted, is still a matter of gueswork.

New officers elected by the chapter are: president, Leo Hungerford, Utility Fan Corp.; vice-president, Myron Kennedy, York Corp.; secretary, Arthur Theobald, Payne Furnace & Supply Co.; treasurer, Robert Lowe, U. S. Engineers.

Named to the board of directors were W. O. Stewart, Harold Hendrickson, James DeFlon, F. B. Gardner and H. S. McClelland.

J. Simon Fluor

LOS ANGELES—J. Simon Fluor, founder-president of the Fluor Corp., Ltd., manufacturers of cooling towers, died early in September at his home in Santa Ana, Calif.

A native of Switzerland, Mr. Fluor came to the United States in 1887. He engaged in the construction business in Wisconsin for many years before moving to California shortly after the close of World War I. In 1920 he established the present firm for designing and building cooling towers and oil and gas plants.

The management of Fluor Corp., Ltd., now is in the hands of sons of the late founder. P. E. Fluor is president, J. S. Fluor, vice-president, and Fred C. Fluor, director and supervisor of equipment.

INSTALL PROVEN PERFORMANCE

NO OTHER UNIT HEATER COMBINES *ALL* THESE ADVANTAGES

BEFORE the war, gas-fired unit heating was rapidly proving its high efficiency and economy of operation for all kinds of buildings, large and small.

Then, as busy war industries were fast expanding, this method of heating proved most advantageous because of its easy installation and ability to deliver quick, clean heat direct to the places it is needed the most.

New improvement in design and construction, plus several exclusive features, already proven in hundreds of installations, will provide even finer heating performance for those who wisely select Janitrol equipment.

The Janitrol line today represents 35 years of continual research and engineering skill devoted exclusively to the perfection of modern gas heating. Janitrol has always lead the gas heating field, but has never used its customers as "guinea pigs". Janitrol equipment must prove its worth in test installations as well as in our laboratories before it is marketed. That has always been Janitrol's policy and we don't intend to change it.

Whether you are a heating contractor, a dealer or a user of equipment, stop and consider how safer it is to install "Proven Performance". Write today for complete descriptive data and information on deliveries of Janitrol Gas-Fired Unit Heaters. Surface Combustion Corporation, Toledo 1, Ohio.

QUICK, SIMPLEST WAY TO PUT HEAT WHERE IT IS WANTED

Ranging from 50,000 to 1,250,000 BTU Input

Propeller Fan Type Unit Heater. For retail stores, restaurants and other commercial establishments. Also used widely in industrial plants.

Blower Type Unit Heater. Similar to the propeller fan type but equipped with a powerful centrifugal fan capable of moving larger quantities of warmed air.

Large Floor Type Unit Heater . . . 1,250,000 Btu input, for heating large areas in industrial plants, warehouses, etc. Like other Janitrol models, it may be operated in multiple.

Floor Type Forced Air Heater. Equipped with filters and humidifier. Unusually quiet fan operation makes it an ideal unit for quality stores and other places where it is more practical to install a floor-type unit.

JANITROL *GAS-FIRED* FURNACES and HEATING UNITS

WHAT READERS SAY

Piping in Ashes

EDITOR, HEATING AND VENTILATING:

I would like to take particular exception to the manner in which T. Napier Adlam, vice-president, Sarco Co., New York, has designed a sidewalk snow eliminator by means of his Radiant Heating method described in his article "Farewell to Snow Shoveling" in the August issue of HEATING AND VENTILATING.

I do not know whether Mr. Adlam is familiar or not with the inevitable result of ferrous piping installed within range of or in close proximity to any sort of under fill or backfill of ashes, but pictured in Figure 2 showing how pipes are imbedded below a 4 in. concrete sidewalk slab on a 5 in. fill of crushed stone laid directly over a 3 in. fill of cinders.

In my "repertoire" of Don'ts in the piping profession the word ashes stands out as one of the greatest factors of destruction in underground piping that I know of and if I may recommend to Mr. Adlam that he substitute a little fill of good substantial clay beneath his crushed stone fill, he will not only acquire a less heat loss downward but a better ground insulator when the clay has dried out after the warm up period has begun.

Ground seepage or high water tables which naturally mix with any cinder fill would instantly release the sulfurous content of the ashes forming hydrogen sulphite; this, in course of time would attack by absorption the steel or wrought iron pipe directly in its path forming a ferrous sulphate disintegrate and the next thing we know the piping system is "gone with the wind."

Another point; if this installation were equipped with an automatic drain fixture, I believe it would be unnecessary in these frequently-thought-of sidewalk defrosters, to add a calcium hydroxide solution or other costly forms of anti-freeze.

Detroit. *A. B. S.*

Mr. Adlam Replies

EDITOR, HEATING AND VENTILATING:

I have read with interest the comments by A.B.S. on my article under the heading "Farewell to Snow Shoveling" and wholeheartedly agree that if my only object had been to play safe, I would not have introduced the layer of cinders for outdoor use. For the same reasons mentioned by A.B.S., I have always been opposed to the use of cinders in close proximity to pipe coils and have repeatedly advised against such practice, although I know of many instances where cinders have been used in connection with indoor floor heating without any ill effect.

I would like to take this opportunity to thank A.B.S. for his kindly thought in bringing out these points, but since my field has been one of research, which was the real purpose of the project under discussion, I must confess that I do not as a rule use a "Don'ts" column as my guide. I have always endeavored to find out for myself exactly what does happen under definite conditions, and while sometimes I use the laboratory to obtain certain kinds of information, I have found the results obtained in that way can be very misleading. It is often necessary to be a little daring and try for results on a large scale if one wishes to learn the true facts.

The detrimental effect which cinders can have on iron or steel pipes when in contact with moisture is fairly well known, but I took the opportunity offered by this project to prove amongst other things what actually will happen to pipes when installed out of doors with a bed of cinders below the broken stone. This question has been put to me so many times that I felt it desirable to get first hand information on a fairly large scale, and under what appeared to be very severe conditions. In addition to ascertaining the effect of cinders on ferrous and other pipes, I am desirous of measuring the loss of heat downwards when pipes are buried outside. The concrete slabs are made removable and I have already lifted and replaced some of the slabs several times for various purposes, and I shall continue my tests until I have ascertained all the information I desire. I have been carrying out some tests to measure the heat loss downwards for indoor work and the project under discussion offered facilities to measure the heat loss downwards for outdoor work.

Perhaps I should have explained more fully in my article that my objects in carrying out this work were:

1. Give employees a dry and safe path to walk on;
2. Test the efficacy of a warm outside surface to prevent the accumulation of ice and snow;
3. Measure the amount of heat required to remove a given depth of snow;
4. Measure as accurately as possible the amount of heat passing downwards to the earth when an outside concrete surface is heated;
5. The effect of cinders as an insulator when placed below broken stone and what effect cinders will have on pipes made of puddled wrought iron and also pipes of other material. For this test and test No. 4 I intend to use different insulating material in place of the cinders to ascertain the best and cheapest method of dealing with such a project;
6. If (2) above is successful, then I hope to design an instrument which will automatically turn on the heating medium immediately snow starts to fall.

As to the second suggestion made by A.B.S., it has already been proved in my preliminary tests that it is dangerous to rely on trying to pass a heating medium through a pipe already below freezing temperature. The pipes were installed with a gradient and fitted with emptying valves at the lower end for the sole purpose of ascertaining if it were possible to turn on the heating medium immediately snow began to fall. However, in my trials with both hot water and steam, the medium became frozen before it reached the end of the pipes, causing stoppages and in one case a split pipe. This fact was referred to in my article as the reason why I resorted to an anti-freeze mixture.

If the results of my investigations prove this method of snow removing to be of value, I may try various anti-freeze mixtures to ascertain the most reliable and yet cheap solution which may be used for outdoor purposes, also for sheds and greatly exposed factory buildings which may be left idle for long periods.

The suggestion of using clay to prevent heat loss is very well known and in many cases very reliable, especially when used in layers with straw or similar material. The dew ponds made centuries ago on the plains and downs of England bear testimony of its value as an insulator of heat. Clay, however, is not always available and in any case it would prevent the seepage of moisture downwards following a rain storm which, by the accumulation of moisture, would aggravate the conditions.

At some future date I hope to give the results of my investigations on all the points mentioned.

T. Napier Adlam

Sarco Mfg. Corp.,
Bethlehem, Pa.

Anthracite Burning

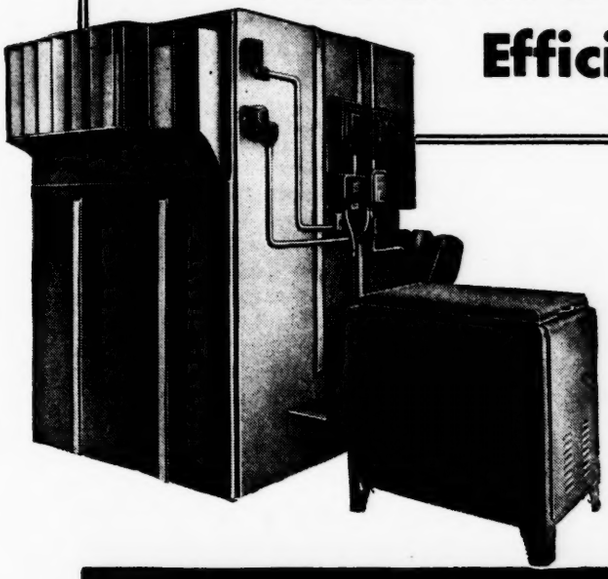
EDITOR, HEATING AND VENTILATING:

The article "Revolutionary Method of Fuel Burning for Anthracite Fired Heating Plants" in your September

(Concluded on page 106)

There's an

AIRTHERM Direct Fired Unit Heater in a Size to Heat Your Plant Efficiently, Economically • •



The Airtherm Direct Fired Unit Heater is made in 6 sizes, from 300,000 to 1,700,000 BTU, to assure you efficient, uniform heat regardless of your floor plan. It spreads heat evenly as far away as 200 feet. The Airtherm can be installed in just a few hours without costly duct work, radiators, or pipes.

Airtherm Direct Fired Unit Heaters have reduced heating costs in many plants in which they have been installed. Let us work with you in planning efficient heat for your plant. Write today for bulletin describing the complete line of Airtherm Direct Fired Unit Heaters.

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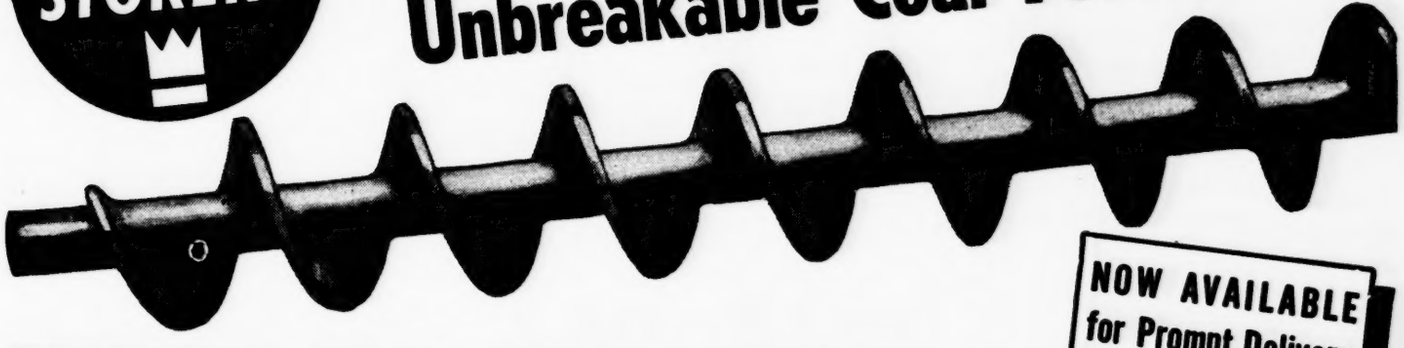
For STOKERS

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY
1229 Tyler St., N. E. *Since 1878* Minneapolis, Minn.

(Concluded from page 104)

issue is most interesting and thought provoking. At the same time there are some points in connection with this device which are not clear to me and perhaps may not be to others. These are:—

1. Your article mentioned efficiencies in the high 60's with from 16 to 18% CO_2 and with flue gas temperatures from 250 to 300F. With such a carbon dioxide content and stack temperatures, the efficiencies should be higher unless there is CO in the flue gas or air leaks which reduce stack temperature. What is your explanation of this lack of heat balance?

2. Your article said nothing about the type of fan being used. Would not the fan necessary for such a boiler be quite noisy?

3. Are automatic controls used on the laboratory installations of this device? It would seem to me that a timer would be necessary as well as some device to prevent the fire banking too far during long banking periods in mild weather.

4. It seems impractical for anybody to expect one motor to run the circulator, screw and fan. Is this anticipated or is more than one motor used in the laboratory installation?

New York. *J. D. L.*

. . . Since the Last Issue

William Goodman, consulting engineer for **The Trane Company,** LaCrosse, Wis., and designer of important air conditioning equipment, has been appointed research professor of refrigeration and air conditioning at **Illinois Institute of Technology,** Chicago. He will begin his duties early in November at the opening of a new term on Illinois Tech's 'round-the-calendar schedule, and will conduct both undergraduate and graduate courses in air conditioning and carry out research studies and experimental investigations in this field. The air conditioning laboratory which includes three experimental units, will be expanded for his use. Mr. Goodman is the author of "Air Conditioning Analysis," a college text and engineering reference book.

William Goodman

First of the 1944-45 industrial instrument maintenance and repair courses of the training school, **Brown Instrument Co.** division of **Minneapolis-Honeywell Regulator Co.,** were started September 25. The classes this fall, according to **Earl M. Robinson,** manager of the company's service division, were attended to the largest extent by personnel from customer plants. The course will continue until and including December 22. Classes from September 25 to October 16 will study millivoltmeter type pyrometers. Mechanical potentiometer pyrometers studies and lectures will be held from October 17 to November 1. Continuous balance electronic potentiometer classes will be held from November 2—9. Other studies and the periods in which each will be covered are: electric operated automatic control, November 10—20; flow meters, November 21—30; thermometers, pressure gauges and hygrometers, December 1—8; air-operated automatic control, December 11—13, and CO_2, analygraph, resistance thermometers and tachometers for the remainder of the period in the order named.

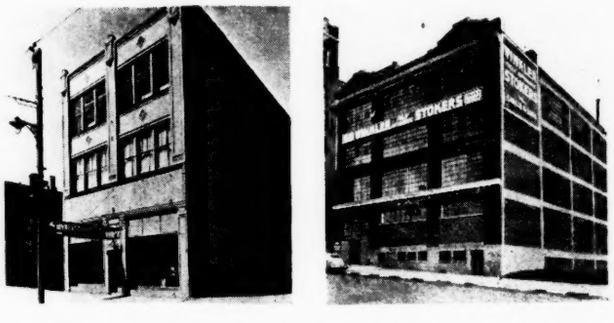
Richmond Radiator Company has purchased from the **Pierce Butler Radiator Corp.,** of Syracuse, N. Y., that company's equipment for the manufacture of its principal lines of boilers and radiators. The equipment will be installed in one of the Richmond plants and will be in production before the end of the year. By the acquisition of these lines, the Richmond company rounds out its own production of gas-fired boilers and air conditioners. Merchandising plans and sales policies are being developed and will be announced in the near future. Richmond Radiator maintains general sales offices at 535 Fifth Avenue, New York N. Y.

An extensive program of research by **Carrier Corporation** to develop equipment to serve the frozen foods industry was revealed in September by **Cloud Wampler,** president. Simultaneously, Mr. Wampler announced the opening of a Carrier Frozen Foods Research Store in Syracuse through which the company will seek to gain a wide variety of experience in the field of frozen foods. George Meek is director of the frozen foods research project. In discussing plans, he reported that Carrier has engaged a graduate home economist, Mrs. Barbara Bornhurst, who will visit owners of home freezers and demonstrate the best ways of preparing and serving frozen foods.

Leo R. Kiley has been appointed Detroit district engineer for the **Vilter Mfg. Co.** with offices in the Donovan Building, Detroit. For seven years previous to his recent appointment Mr. Kiley was in the application engineering division of Vilter where he was engaged in layout and design.

Five synthetic rubber pilot plants are now under construction for leading rubber companies and are expected to reach completion early in the new year, according to **Blaw-Knox Company,** designers and engineer-contractors of the quintuple project. Developments of new types of synthetic rubber polymers for further improving automobile tire and other synthetic rubbers is the overall purpose of the pilot plant installations. Plants are being built for **Firestone** at Akron; **Goodyear** at Akron; **U. S. Rubber** at Naugatuck, Conn.; **Copolymer Corp.** at Baton Rouge; and **National Synthetic Rubber Co.** at Louisville.

U. S. Machine Corp., Lebanon, Ind., has leased warehouse facilities in New York City and purchased its Chicago branch property. The four-story leased property is located at 70 West End Avenue. **Cecil Connor** has been named manager of the parts division and **J. O. Williams** is Winkler sales manager of metropolitan New York. The recently purchased Chicago branch at 1614



Chicago warehouse (left) and New York branch (right) of U. S. Machine Corp.

South Wabash avenue is managed by **Cecil V. Matthews** and was established by the company in 1941. **A. H. Porche** is Chicago district sales manager. The three Lebanon Winkler plants have been expanded to 250,000 square feet.

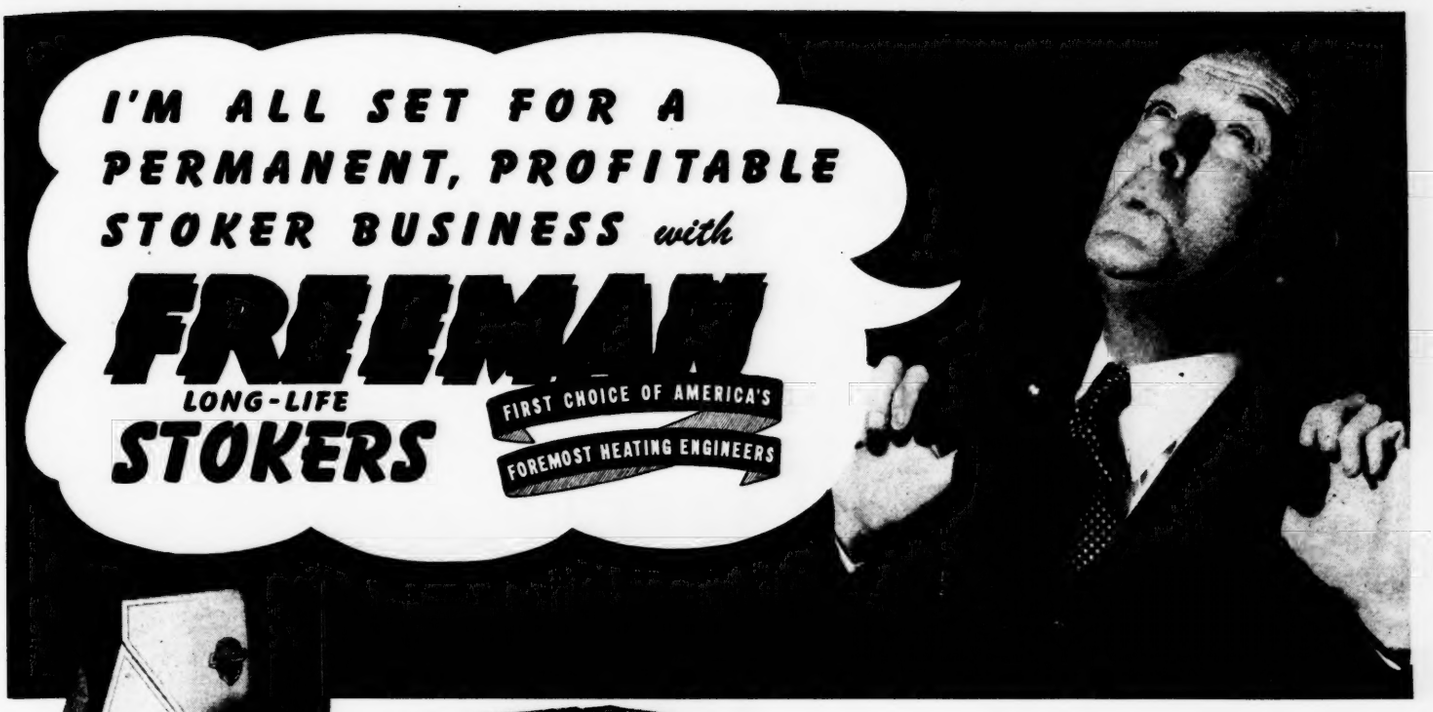
(Continued on page 108)

I'M ALL SET FOR A PERMANENT, PROFITABLE STOKER BUSINESS with

FREEMAN

LONG-LIFE STOKERS

FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS



Available for Prompt Delivery

COMPLETE RANGE OF SIZES: 65 TO 1200 POUNDS PER HOUR

Freeman . . . a pioneer of the stoker industry and one of the leaders in national sales volume . . . offers you a complete line, a success-proved promotion program, and the security of a dependable, financially strong manufacturer who will always be in the stoker business to serve you! It will pay you to get full details . . . immediately.

FREEMAN STOKER DIVISION, ILLINOIS IRON & BOLT CO., 918 SO. MICHIGAN AVE., CHICAGO 5, ILL.

It takes the Niagara DUO-PASS to ASSURE the Advantages of evaporative condensing!

● Users of the Niagara AERO EVAPORATIVE CONDENSER have saved up to 35% of power while increasing useful refrigerator capacity obtained without increasing compressor equipment. This has been achieved by reducing compressor head pressure.

Only the Niagara DUO-PASS Aero Condenser assures these gains because only the Niagara Condenser has the patented DUO-PASS which lowers temperatures so that no deposit of salts or scale is precipitated on the condenser tubes. This improvement secures the full capacity of the evaporative condenser throughout its long life.

The Niagara DUO-PASS AERO CONDENSER also saves the user the cost of 95% of his condensing water and the installation expense of water-handling equipment. For complete information and records of users' savings, write to

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"25 Years of Service in Air Engineering"

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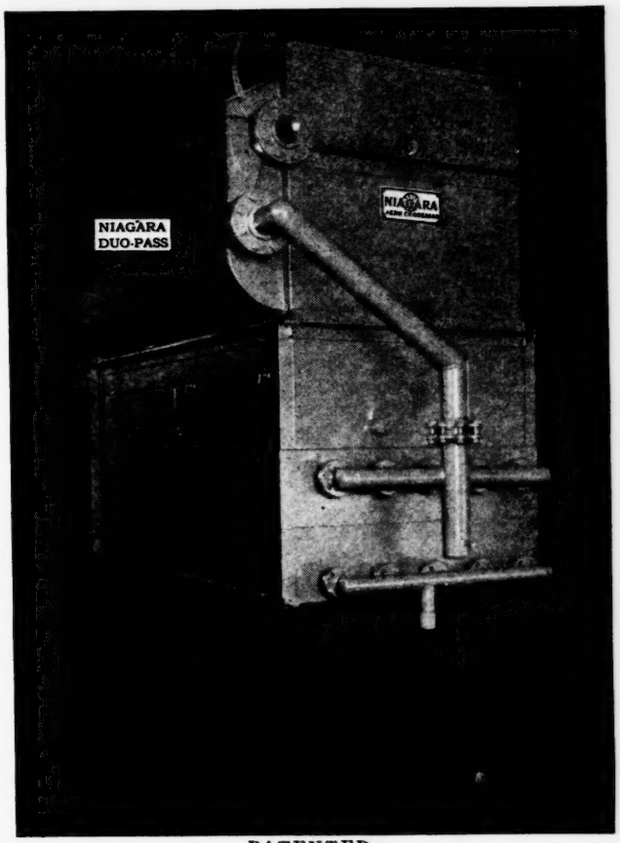
Field Engineering Offices in Principal Cities



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NIAGARA INDUSTRIAL COOLING • HEATING • DRYING HUMIDIFYING • AIR ENGINEERING EQUIPMENT

(Continued from page 106)

Three appointments have been made to executive positions in the sales and advertising departments of **The Philip Carey Mfg. Co. Harold D. Bates** has been named advertising and sales promotion manager. Mr. Bates has had more than twenty years experience in the promotion of building materials and industrial products and was assistant advertising and sales promotion manager for Johns-Manville, New York, prior to his present appointment.

Chester L. Owens has been named assistant general sales manager. Mr. Owens joined Carey as a salesman in 1927 and later served as branch manager at Omaha and Chicago. For the past ten years he has been manager of the Company's Cincinnati branch.

George B. Johnston who becomes general merchandising manager was formerly manager of the marketing division. In his nineteen years with the Carey organization, he also served in various capacities including manager of the contract department at Louisville and assistant branch manager at Chicago.

All three men will make their headquarters at Cincinnati.

Republic Flow Meters Co., Chicago, Ill., has appointed **Merrill Berkley** as its exclusive representative in Southern California and portions of Nevada and Arizona. Mr. Berkley's office is in the Lincoln Building, 742 So. Hill Street, Los Angeles 14, Calif.

Effective September 18, **Lucien W. Moore,** previously general purchasing agent of **Crane Co.,** has been appointed manager of the valve and fitting sales department, with headquarters at Crane's general offices in Chicago. Before his appointment as purchasing agent, Mr. Moore had many years of experience in the sale of Crane valves, fittings and pipe. He is succeeded as purchasing agent by **Thomas J. Hanlon.**

W. A. Matheson was elected president of the **Williams Oil-O-Matic Heating Corporation** by the board of directors at a special meeting held at Bloomington, Ill., Sept. 18. In addition, Mr. Matheson was named general manager of the corporation. **W. W. Williams,** former president, was elected chairman of the board of directors—a newly created office. Prior to 1937, Mr. Matheson spent ten years in Oil-O-Matic sales activity in the Pacific northwest, in Philadelphia, and in Chicago where he also served as manager of the Oil-O-Matic branch. After an interval with General Motors, Mr. Matheson returned to the Williams Oil-O-Matic Heating Corporation in September, 1940, to man the newly-created post of assistant to the president.

W. A. Matheson

The board of directors of **The Kennedy Valve Mfg. Co.,** Elmira, N. Y., has elected **Leon H. Marsh** as vice-president and sales manager. Mr. Marsh has been associated with the Company for more than 25 years. After having been assistant sales manager for many years, he was made acting sales manager in 1941, and was promoted to the position of sales manager in 1942. He will be in charge of all sales and public relations.

The J. O. Ross Engineering Corp., New York, has opened a new branch office at 79 Milk Street, Boston 9, Mass. The Boston office is in charge of Frank W. Partsch, vice-president.

Walter H. Ridley has joined the sales promotion department of **The Foxboro Company** at the head office, Foxboro, Mass.

James L. Dunn, assistant plant manager of the Bridgeport plant of **Jenkins Bros.,** was elected by the board of directors on September 14 to the post of vice-president in charge of industrial relations. Mr. Dunn has been associated with Jenkins Bros. since 1913. Mr. Dunn started his business career in 1911 as an office boy in Boston. Later starting as a clerk in Jenkins Bros., he rose to the position of production manager, business manager, and then assistant plant manager.

James L. Dunn

Julian Warren

Julian Warren has been appointed manager of advertising and sales promotion of **Delco Appliance Division, General Motors Corp.,** Rochester, N. Y. Mr. Warren has been associated with the Division for several years in sales and executive work.

Ben M. McDougall has been appointed field engineer for the southeastern territory of **Alco Valve Co.,** with headquarters at Atlanta, Ga. This territory includes Georgia, Florida, South Carolina, Alabama, N. C., Mississippi, Louisiana and East Tennessee. Mr. McDougall became associated with Alco in 1940 when, with headquarters in New Orleans, he served the refrigeration industry in several southern states as manufacturer's agent. He later moved to Birmingham, but early in 1943 this office was closed because of war conditions. Mr. McDougall then came to St. Louis, where he has been doing test engineering work in Alco's refrigeration laboratory. Alco Valve Company's Atlanta address is 423 C. & S., National Bank Building.

Irwin R. Hoffman has been appointed co-ordinator of the New York Metropolitan District for the National Fuel Efficiency Program, conducted in cooperation with the Bureau of Mines. The program is designed to prevent the development of a critical situation in the supply of various fuels.

Cecil Farrar, formerly president of Excelso Products Corporation, has joined **Richmond Radiator Company** as sales manager of its Plumbing Division. Mr. Farrar will work closely with **Mr. John J. Hall,** Richmond's vice-president and general manager of sales. Mr. Farrar has been actively associated with the plumbing and heating fields for over thirty years. Starting with American Radiator Company in 1906, he has been continually active in the selling and executive ends of the industry.

Cecil Farrar

William A. Minkler has been appointed application manager for air conditioning of the **Westinghouse Electric Elevator Company.** A graduate of California Institute of Technology in 1927, Mr. Minkler first joined Westinghouse that same year. In 1931, when Westinghouse started production of air conditioning apparatus, Mr. Minkler became identified with this activity. From 1941 to 1944 he was air conditioning sales manager of the Young Radiator Company, returning to Westinghouse this year.

(Continued on page 110)

Brother, when You Seal a Joint with X-PANDO You know it won't leak!

If you want to know why X-Pando Pipe Joint Compound is standard in American Industry and Shipbuilding—why the U. S. Army, Navy, Coast Guard, Maritime Commission and Army Air Corps use it—why the pipe shop men who take no chances *insist* on X-Pando, here are the reasons.

It expands as it sets

THE ONE FORMULA—FOR ALL USES!

X-Pando corrects imperfections in threads and flanged faces. It's economical, goes 6 times further. Holds anything carried in metal pipe except certain heavy acids—expands and contracts with pipe movement—yet joints may be easily taken apart—smoothes flange faces—X-Pando withstands deflection, sharp temperature changes—vibration and pressures—better than litharge and glycerine for all uses. More than a pipe joint compound. It is an all purpose industrial sealing agent.

If you want to end leaks permanently, specify X-Pando—the best—costs less.

Distributors Everywhere.

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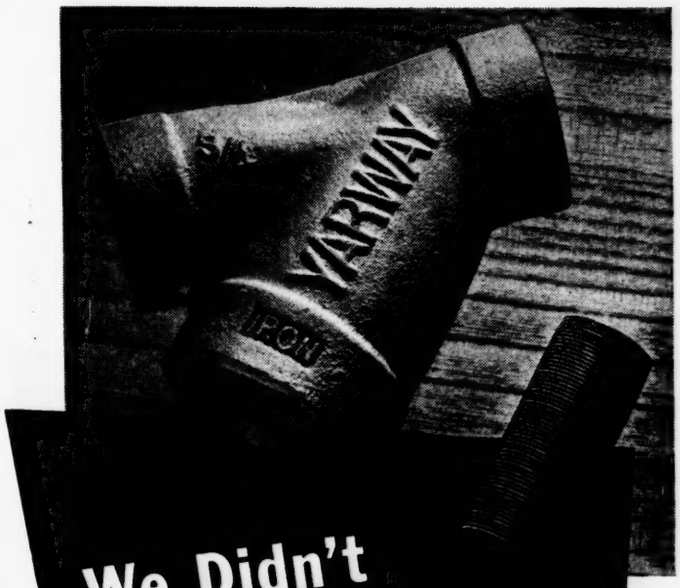


We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the ***YARWAY Strainer.***

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion —*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt —lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY

104 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

(Continued from page 108)

C. W. Cornelssen has joined **Williams Oil-O-Matic Heating Corp.**, Bloomington, Ill., as manager of heating sales. He was formerly associated with Harvey-Whipple, Inc., Springfield, Mass., as sales manager. Mr. Cornelssen has been prominently identified with the oil burner industry for over 20 years in an executive sales capacity. He was assistant sales manager of Socony Burner Corp. for over four years. Later he joined May Oil Burner Corp., Baltimore, where he remained for nine years, as manager of the Baltimore branch and assistant to the president. He also served as New England sales manager. Following this, Mr. Cornelssen was sales manager of a large Metropolitan New York distributor for oil burners and fuel oil.

C. W. Cornelssen

W. A. Meyer has been appointed manager of dealer sales of the **Allis-Chalmers Mfg. Co.** He succeeds **S. H. Gorham**, who has resigned. With Allis-Chalmers since 1926, Mr. Meyer has served in the milling machinery, Texrope, and central sales departments, and was manager of general purpose equipment sales before his appointment. He has been particularly active in the field of multiple V-belt power transmission and is vice-president and chairman of the executive committee of the Multiple V-belt Drive Association.

Penn Electric Switch Co., Goshen, Ind., reports that permission was granted by WPB, August 24, for the construction of additional office space to relieve the present congestion and inadequate facilities for the company's workers. This is the fourth building expansion for Penn since its move to Goshen from Des Moines in 1937.

Tube Turns, Inc., Louisville, Ky., has appointed **Ches Herndon** as manager of the company's Houston branch with offices in the Commerce Building. A native of St. Louis, Mr. Herndon's associations with supply firms in the Southwest dates from 1926. He was with Hanlon Waters, Inc., in Tulsa for 13 years.

The **Pomona Pump Co.**, division of the **Joshua Hendy Iron Works**, Pomona, Calif., was taken over early in September by **Fairbanks, Morse & Co.**, for a consideration announced as $4 million. As part of the transaction, it was stated that the Chicago company was also to take over the Pomona Pump Co.'s plant in St. Louis, Mo.

Pomona Pump Co. was founded as the Pomona Mfg. Co. in 1902 to manufacture a patented deep-well pump and in 1924 control was purchased by McKenna & Sons. On December 31, 1942, the Joshua Hendy Iron Works purchased the McKenna interests and went into war production. Recently the executive and sales division had been transferred from Pomona to the main Hendy plant at Sunnyvale, Calif. Under Fairbanks, Morse & Co. operation, the Pomona pump division will be manufacturing headquarters of the company on the Pacific Coast and all operating personnel will be retained. Manufacturing and sales forces are being returned to Pomona from Sunnyvale.

Richard N. Meyer has recently been appointed field manager of the St. Louis territory of **Alco Valve Company.** The territory includes Kansas, Missouri, Arkansas, Kentucky, southern Illinois, southern Indiana and the western Tennessee. Mr. Meyer has been manager of Alco's service department for the last two years. Prior to that he was sales engineer with the St. Louis branch of the New York Corporation.

Acquisition of the **Whiting Stoker Company** of Chicago by the **Lidgerwood Mfg. Co.**, 71-year-old Elizabeth, N. J., manufacturer of heavy-construction machinery, is announced by **A. E. Bottenfield**, executive vice-president and general manager of the new Whiting affiliate. The purchase includes the manufacturing and sales rights and all interests in Whiting Continental and Butler stokers. A new company has been formed, the **Whiting Stoker Sales Company**, with offices in Chicago, and will operate as an affiliate of Lidgerwood. Its officials are: **L. D. Tenerelli**, president of Lidgerwood, chairman of the board; **W. G. Schalscha**, executive vice-president of Lidgerwood, president; **A. E. Bottenfield**, general manager of the present Whiting Stoker Company, executive vice-president and general manager; and **G. L. Reeh**, treasurer of Lidgerwood, treasurer. The Whiting Stoker sales and engineering staffs will be incorporated in the new company. Lidgerwood manufacturing plants at Elizabeth, Newark, and Superior, Wis., will produce the stokers.

W. R. Persons, Pittsburgh district manager of **The Lincoln Electric Company**, Cleveland, Ohio, has been transferred to the factory and main office at Cleveland to carry out a special post-war planning assignment.

Sullivan Valve & Engineering Co., Butte, Mont., has been appointed distributors of **H. B. Smith** boilers in Montana and Northern Idaho.

J. E. Axeman and **W. S. Anderson, Jr.** have organized a new company, **Axeman-Anderson Associates**, 233 West St., Williamsport, Pa. For the present the company will devote all its time to research work for the anthracite industry, in the development of heating equipment, using the new basic principle of burning anthracite recently announced by **Anthracite Industries, Inc.** Mr. Axeman

J. E. Axeman *W. S. Anderson, Jr.*

was formerly with Spencer Heater Division, Williamsport, for twenty years, coming to Spencer as a student engineer immediately after his graduation from Pennsylvania State College in 1924. He served his former company in various capacities, the position recently relinquished being that of general sales manager. Mr. Anderson was educated at Stevens Institute of Technology and Columbia University. For the past twelve years he was chief engineer at Spencer Heater, most of this period being engaged in development work. Prior to coming to Spencer Heater he was associated with the Bigelow Company at New Haven, Conn., and was also development engineer for a period with the Riley Stoker Corporation, Worcester, Mass. He is credited with having developed the first successful La Mont forced circulation boiler.

John P. Rainbault, who recently resigned as manager of the air conditioning and commercial refrigeration department of General Electric Company, has formed the **John P. Rainbault Company**, manufacturers representatives, with offices in the Phelan Building, San Francisco. The organization will represent on the West Coast several nationally known manufacturers, among whom are **The Viking Mfg. Corp.**, Dayton, Ohio, and **The Karpark Corp.**, Cincinnati.

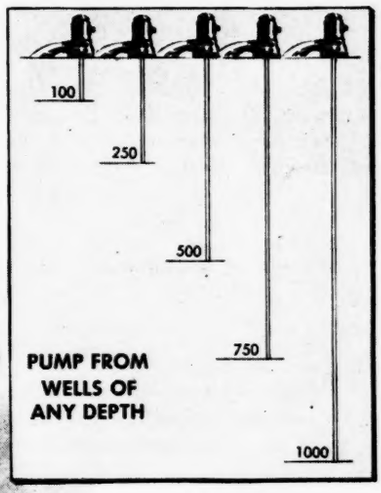
(Continued on page 112)

TAP
LOWER WATER LEVELS *with a Peerless*

Water levels are receding in many parts of America. This critical situation was discussed most forcefully in a recent issue of The Saturday Evening Post. It's a problem that confronts many pump users—perhaps you.

To tap the lower water levels you need a Peerless Deep Well Pump. Look ahead. Make provision for a dependable source of water for years to come by going deeper for your water. Peerless Pumps will lift water from any depth and can be installed to meet the receding water levels. Some are installed more than 900 feet deep.

Peerless Pump heads are designed and engineered to carry the load. The Peerless Moturbo Head, with its built-in, hollow-shaft motor, water-cooled, oversize bearings and the shaft with oil or water-lubricated bearings, insures economical operation and high efficiency.

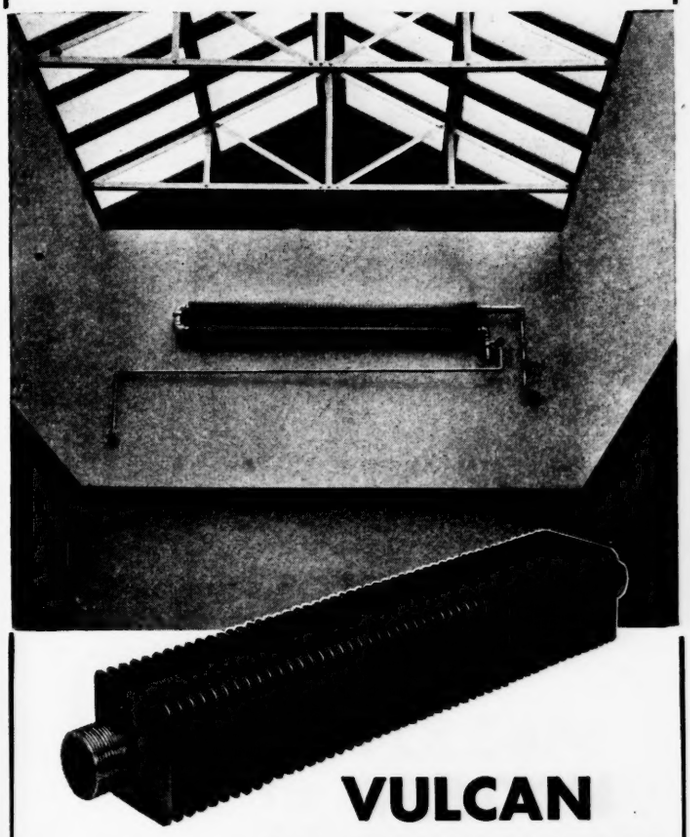


PEERLESS PUMPS

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
301 W. Ave. 26, Los Angeles 31, Calif. • 1250 Camden Avenue S.W., Canton 6, Ohio • *Other Factories:* San Jose 5, Fresno 16, California

FOR BETTER HEATING AND EASIER INSTALLATION



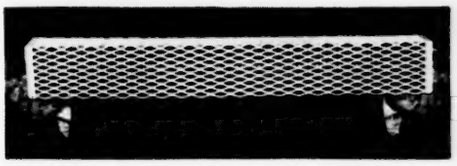
VULCAN
FIN-TYPE RADIATORS

Imagine the difficult and cumbersome job that would be encountered installing heavy pipe or cast iron radiators in place of the VULCAN fin-type installation shown above. In this case VULCAN radiation was installed easily and effectively in that heat distribution was provided where it was needed and cold down drafts were eliminated.

This is only one of many applications where VULCAN serves to maintain even temperature control. In hospitals, churches, theatres, auditoriums, schools, ships and industrial plants all over the country VULCAN is proving through its wide range of use and application to be the accepted modern radiator.

Send for latest Catalog showing performance charts.

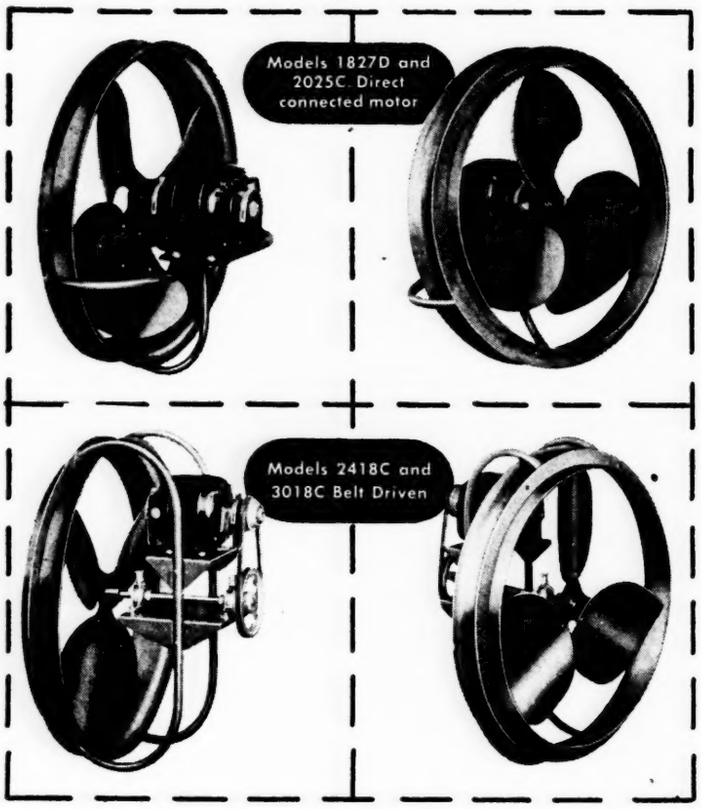
Where desired, grille covers can be furnished for VULCAN radiation.



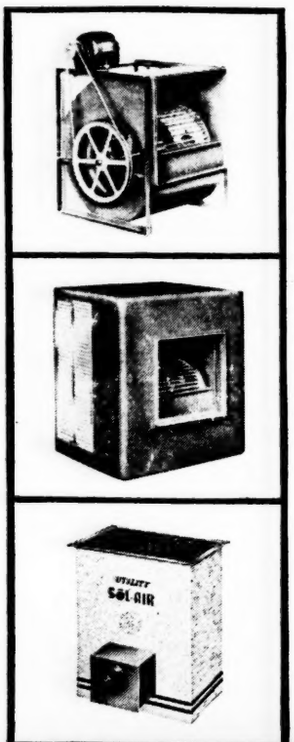
VULCAN RADIATOR CO.

26 FRANCIS AVENUE HARTFORD 6, CONN.

RADIATOR MFGS. FOR ALMOST TWO DECADES



NEW UTILITY FANS ARE *Truly Quiet*



The streamline fan ring permits a smooth flow of air with minimum turbulence and noise . . . the fully enclosed motor is resilient mounted . . . low rotative speeds further air quiet operation. Other features are low power consumption and rigid, welded construction. Belt-driven models have variable pitch pulley for simple speed adjustment. All models are easily installed by means of the rigid, heavy gauge steel ring mounting.

Utility Propeller Fans, Centrifugal Blowers and Evaporative Air Coolers are available under WPB regulations. Write for complete catalogs and literature.

UTILITY FAN CORPORATION
4851 South Alameda Los Angeles 11, California

Peace-time manufacturers of the Famous Utility Air Koolers, Blowers, Fans, Floor Furnaces, Circulating Heaters, Unit Heaters, Forced Air Furnaces.

(Continued from page 110)

Worthington Pump and Machinery Corp., Harrison, N. J., announces that **C. W. Camp**, formerly with Crocker-Wheeler Electric Mfg. Co., for 38 years, specializing in application engineering, is now associated with Worthington as consulting electrical engineer. A former executive member of the National Association of Electrical Manufacturers, Mr. Camp, who replaces the late Harry Wood, will assist in solving electrical application problems for all Worthington sales divisions and district offices. His services will also be utilized by the company's manufacturing departments.

Delco-Heat dealers and distributors throughout the United States have been holding informal conferences to talk over post-war products and merchandising. Meeting with them have been various representatives of the **Delco Appliance Division, General Motors Sales Corp.**, Rochester, N. Y. These include **M. Lawrence Judd**, sales manager; **Charles E. Smith**, assistant sales managers; **Julian Warren**, advertising manager; **Kenneth O. Wolcott**, service manager. Entitled "Plans for Tomorrow," the subject matter discussed has included the various automatic Delco-Heat units to be furnished for both immediate and future post-war selling, and the sales and advertising program covering their distribution. Cities in which conferences have been held include, among others, New York, Chicago, Detroit, Milwaukee, Omaha, Toledo, Kalamazoo, and Sioux City.

Struthers Wells Corp., Titusville, Pa., has announced the appointment of **John R. Collette** as manager of its new Heating Boiler Division, to be operated as a part of the Titusville Boiler Division of Struthers Wells Corporation. Mr. Collette was for 23 years vice-president of the Pacific Steel Boiler Division of the U. S. Radiator Corporation, Detroit. Titusville has been building low pressure steel heating boilers since 1860, until the urgency of war contracts made it advisable to temporarily discontinue their manufacture. Present plans call for the post-war manufacture of a complete line of steel heating boilers.

J. R. Collette

Penn Electric Switch Co., Goshen, Ind., has opened a branch sales office in Dallas, Texas, located in the Wilson Building. The branch will be managed by **Ray P. Waite**, a graduate mechanical engineer, who also has had considerable experience in electrical and chemical engineering. Mr. Waite was in the public utility business until 1932 at which time he was vice-president and general manager of a mid-west utility company. Since 1932, he was engaged in consulting engineering and in this capacity has done sales, sales promotion and product research work.

Howard P. Vermilya has been appointed director of housing research of the **John B. Pierce Foundation.** Mr. Vermilya has for the past ten years been connected with the Federal Housing Administration as technical director.

Dravo Corp., Pittsburgh, Pa., has elected **L. A. Mertz** as vice-president. He will retain his previous position as treasurer. Other elective offices filled at a recent meeting of the board of directors were: **C. A. Hill**, comptroller, formerly secretary and auditor; **C. E. Walker**, secretary and auditor, formerly assistant to president. **W. T. Conlon** was appointed to succeed Mr. Walker as assistant to the president, **V. B. Edwards.**

Atmos Corporation has moved to larger quarters at 955 West Schubert Ave., corner Sheffield Ave., Chicago 14, Ill.

Latin American industrialists are to be offered an opportunity to provide groups of employees of their own choosing with free technical and practical instruction in precision industrial instrumentation in this country, it is made known by **E. B. Evleth,** vice-president and general manager of **Brown Instrument Co.,** precision industrial instrument division of **Minneapolis-Honeywell Regulator Co.** Instruction will be conducted at the Brown School of Instrumentation in Philadelphia.

To further the plan, Pan American World Airways has agreed to make every effort to give as much preference as possible to Latin American students for transport from PAA South American airports.

The school has no tuition fee. The expenses of the students while studying are paid by the companies which send them to Philadelphia for instruction.

Airtemp Division, Chrysler Corp., Dayton, Ohio, has appointed **William J. Porter** as district engineer in the New England territory. Porter was formerly with the marine division of Carrier Corp., and prior to that with Jaros, Baum & Bolles, consulting engineers in New York.

Fred C. Staehle, Jr., returned to an inactive status from the army in July, will become a district representative in the Dallas, Tex. area for Airtemp.

W. S. Moellering has joined the Airtemp field organization as district representative in the Dayton area.

Frederick W. Smith, for nineteen months chief of the special equipment branch of the general industrial equipment division of the War Production Board, will become associated with **Carrier Corporation,** November 1. The special equipment branch of WPB has jurisdiction over five important industries, including refrigeration and air conditioning. Prior to his association with WPB, Mr. Smith was for sixteen years connected with the Frigidaire Div., General Motors Corp., in a variety of capacities, including application engineer, district sales manager, and most recently New England manager of the commercial refrigeration and air conditioning division of the company.

Edgar C. Brandt has been appointed assistant to the general manager of the **Crocker-Wheeler Electric Mfg. Co., Div. of Joshua Hendy Iron Works.** Prior to his connection with Crocker-Wheeler, Mr. Brandt was associated with the Elliott Company as vice-president and general manager, and with the Westinghouse Electric Mfg. Co.

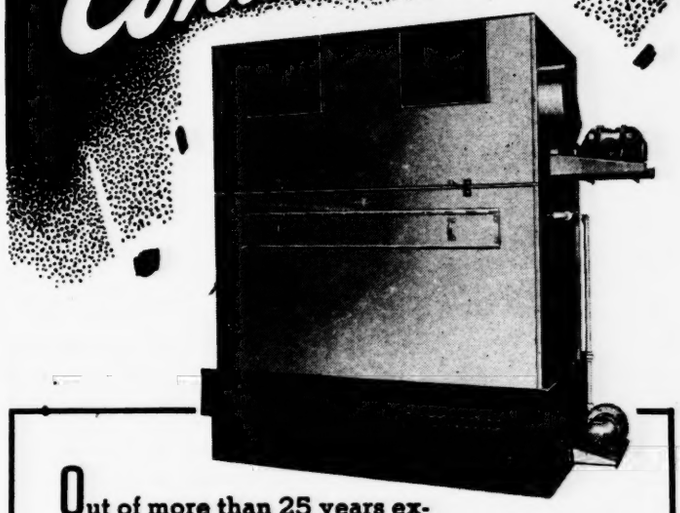
Frederick K. Lovejoy has been appointed manager of its Kansas City district sales territory by **American Machine and Metals, Inc.,** East Moline, Ill. For 14 years, Mr. Lovejoy was associated with the Consolidated Laundries Corporation, New York City. Headquarters of the Kansas City district office, of which Mr. Lovejoy is manager, are in the Midland Building of that city.

Jack Spalding, Jr., formerly president of **Air Devices, Inc.,** 17 East 42nd St., New York, N. Y., has severed his connection and disposed of his interest in that company in order to devote all his attention to the establishment of a large scale experimental dehydration plant at Greenville, R.F.D. 2, S. C.

The Stokermatic Company, Salt Lake City, Utah, has been purchased by the **Rheem Manufacturing Company,** peace-time manufacturer of automatic water heaters and other household utilities. **Horace U. Siegel,** for many years general manager of the Stokermatic Company, is the manager of the Stokermatic Division of Rheem Mfg. Co., with **Charles Murdock,** also a stoker pioneer, in charge of stoker engineering. The vice-president in charge of sales of Rheem Mfg. Co. is **L. B. Keplinger,** with headquarters in New York, N. Y.

(Concluded on page 114)

Evaporative Condensers



Out of more than 25 years experience comes the development of this year's models of Acme Evaporative Condensers.

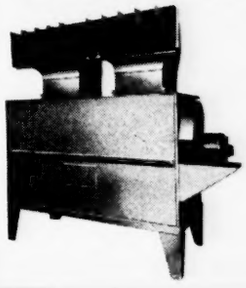
Wherever water supply presents a problem they furnish the most efficient and economical solution. For Acme has found a way to provide plenty of cooling surface without the use of fins and conserve valuable space.

Cooling coils are all prime surface and especially designed for evaporative condensers.

Definitely they're more efficient. A wide range of capacities. Write for catalog No. 27.

☆ ☆ ☆

BLO-COLD FORCED AIR COOLERS



● Floor type units for high or low temperature requirements wherever forced air cooling is advisable. Dry fin coil type and brine spray models—a unit for any job. Our engineers are at your service if they can be of help to you. For complete recommendations, write for Catalog No. 32.

ACME PRODUCTS

ACME PRODUCTS

Evaporative Condensers	Forced Convection Units
Ammonia Condensers	Pipe Coils
Freon Condensers	Heat Interchangers
Dry-Ex Water Coolers	Oil Separators
Flooded Water Coolers	Liquid Receivers
Hi-Peak Water Coolers	Heat Exchangers

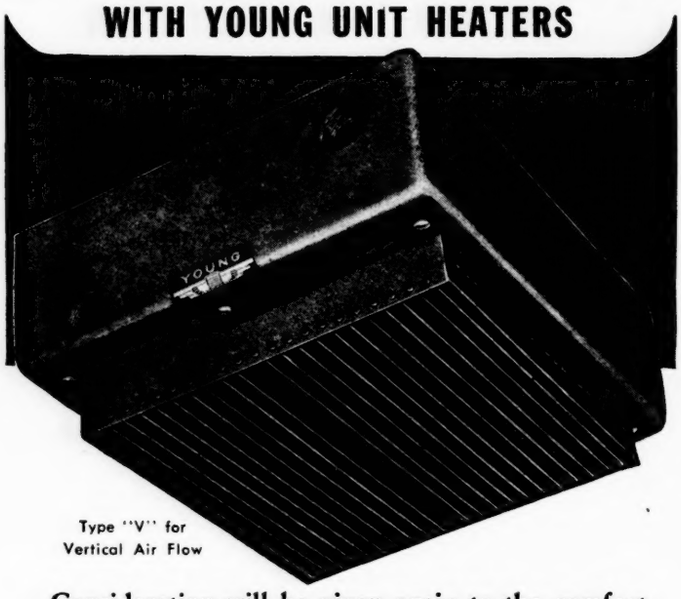
Write for Catalog on any item.

ACME INDUSTRIES
JACKSON, MICHIGAN

DISCOMFORT DEFEATS PEAK PRODUCTION

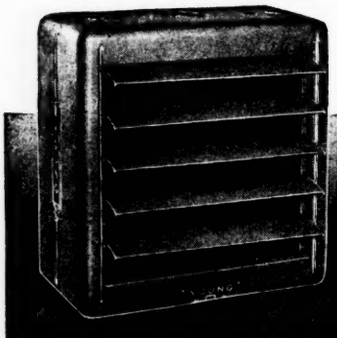
WARM UP *the* COLD SPOTS

WITH YOUNG UNIT HEATERS



Type "V" for Vertical Air Flow

Consideration will be given again to the comfort and health of war workers this winter . . . not only to prevent illness that results in absenteeism, but to invite employment and increase production efficiency. If heating facilities were inadequate last year, if cold spots were detected or if departments have been rearranged, Streamaire Unit Heaters, designed by Young, can be used to advantage. Their saving of floor space, ease of installation, low first cost, efficient operation and low maintenance cost, make Young Unit Heaters desirable for existing or new buildings and additions. Write us direct or consult with the Young representative in your locality for assistance in planning heating and air conditioning installations.



Type "SH" For Horizontal Air Delivery

BUY BONDS
PRODUCE MORE
SALVAGE SCRAP
WIN THE WAR

YOUNG

HEAT TRANSFER ENGINEERS

Manufacturers of Oil Coolers • Gas, Gasoline, Diesel Engine Cooling Radiators • Intercoolers • Heat Exchangers • Engine Jacket Water Coolers • Unit Heaters • Convectors • Condensers • Evaporators • Air Conditioning Units • Heating Coils • Cooling Coils • Complete line of Aircraft Heat Transfer Equipment.

YOUNG RADIATOR CO., DEPT. 104K, RACINE, WIS.

Application Engineers in Principal Cities

(Concluded from page 113)

At a meeting of the directors of **Kol-Master Corporation,** stoker manufacturers, **R. E. Bressler,** formerly vice-present and chief engineer, was elected president and treasurer to succeed the late **Jos. F. Reed,** who died on June 12. **Henry G. Wickham** was elected vice-president and **Jos. C. Reed,** secretary. All were elected to the board of directors.

Ergolyte Mfg. Co., 3627 N. Lawrence Street, Philadelphia, has purchased the equipment and inventory of the Precision Engineering Company, 4632 Armitage Street, Chicago.

Tube Bending

An 8-page colored bulletin entitled "Leonard-Douglas Bendmaster" and describing and illustrating in detail the application of this device to production bending of tubing. *Leonard Precision Products Co., 1100 Larson Avenue, Garden Grove, Cal.*

Water Conditioner

A folder devoted to K.A.T. water conditioners and anti-scale, anti-corrosion and anti-foam treatment recommended for water stills and evaporators. *K.A.T. Corporation, 331 Madison Ave., New York 17, N. Y.*

Steel Tubing

A 5½ x 8½ in. 24-page bulletin No. 112 entitled "Bursting Pressures of Seamless Steel Tubing" and including reference charts for engineers with tables of bursting pressures for ⅛ to 9⅝ in. O.D. tubing. *Globe Steel Tubes Co., Milwaukee 4, Wis.*

Steam Heating

Brochure No. 632, 24-pages, entitled "High Altitude Heating for Buildings" and devoted to the Dunham differential vacuum heating system. The book explains the evolution of steam heating, explains the parallel between the use of high altitudes for flying and the use of atmospheric pressures for steam heating and then describes and explains the differential vacuum system and its equipment in detail. Includes an impressive group of photographs of installations where system has been installed. *C. A. Dunham Co., 450 E. Ohio St., Chicago, Ill.*

Air Scrubber

Bulletin 205 describing the Ross air scrubber which, unlike many types of air washers, contains no spray nozzles and requires no extensive piping to install. Scrubbers intended for use in humidifying, dehumidifying, cooling and fume elimination. Bulletin explains how they can also be utilized to heat white water or fresh water without the need for steam and a schematic layout for such water heating is included. *J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.*

Decarbonator

Bulletin 2975, descriptive of Cochrane decarbonators for removing certain dissolved gases from water solution. Data are included and description is given of the method of operation. *Cochrane Corp., 17th and Allegheny Aves., Philadelphia 32, Pa.*

Vibration

A 6-page folder entitled "Control" and devoted to the part played by vibration control devices in reduction maintenance production, product quality and building protection. Illustrates and describes the applications of the company's product through such equipment as fan bases. Includes reference chart. *Vibration Control Co., 545 Fifth Ave., New York 17, N. Y.*

Plastic Coatings

A 16-page catalog on Amercoat plastic coatings. Illustrates and describes the uses of these coatings in a wide range of industries, including a comprehensive list of organic and inorganic materials, foods and beverages and actual equipment and structures that are now being protected against corrosion or contamination. *Amercoat Division, American Pipe and Construction Co., P.O. Box 3428 Terminal Annex, Los Angeles 54, Calif.*

Welding Fittings

A 20-page booklet giving allowable working pressures for welding fittings in five classes of piping—power, oil, district heating, gas and air, and refrigeration. Fourteen convenient tables list allowable pressures at the indicated temperatures for any size and weight Tube-Turn fitting. All tabulations are made in accordance with the Code for Pressure Piping A.S.A. B31.1—1942. *Tube Turns, Inc., Louisville, Ky.*

Rubber Goods

Produced especially for designers of industrial equipment as well as consumer products, a general booklet on the company's industrial rubber products. Included in the booklet are discussions of the company's line of Vibro-Insulators, devices of rubber and metal which reduce vibration, molded, extruded, lathe cut and sponge rubber products, rubber lined tanks and valves, products made with Koroseal, the company's flexible material created from plasticized polyvinyl chloride, V-belts and cements. *The B. F. Goodrich Co., Akron, Ohio.*

Controls

Two standard size bulletins devoted to the Johnson electronic Duo-Stat. Bulletin 396, ten pages, describes the Duo-Stat, its method of operation and the equipment employed in Duo-Stat systems; Bulletin 396-A, 14 pages, covers technical installation data for the device, its specifications, performance data, information on temperature adjustment, ratios, location of thermostatic elements, and wire arrangements for different types of systems. *Johnson Service Co., Milwaukee 2, Wis.*

Conduits

Catalog 44, standard size, 12 page bulletin, devoted to the company's conduit systems for underground and overhead steam, oil or hot water lines. Arrangement and construction of the types F and SPC insulated pipe units with fiber insulation and with sectional pipe covering, respectively, are described on the first two pages, followed by information on prefabricated expansion loops, tables of conduit capacities, typical specifications, summary of advantages, together with brief descriptions of the company's tile conduit, standard type, universal type, supertile conduit, cast iron conduit and tile conduit type SPC, together with dimensional and capacity information on these types. Also included is a page devoted to uses of the insulated pipe units for piping oil and other viscous materials. *The Ric-wil Co., 1563 Union Commerce Bldg., Cleveland, Ohio.*

● T-80 SERIES THERMOSTATS are also available in Package Sets, together with B-60 gas control with tamper-proof cover and integral pilot valve assembly; 30 feet of wire; and thermocouple pilot generator. *Everything needed,* in a convenient package, for quiet, safe, automatic control of central and floor furnaces, boilers, radiators, gas ranges and water heaters.

WRITE FOR CATALOG 52